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ABSTRACT

This manual addresses court design and planning; the construction process; court surface selection; accessories and amenities; indoor tennis court design and renovation; care and maintenance tips; and court repair, reconstruction, and renovation. General and membership information is provided on the U.S. Tennis Court and Track Builders Association and the U.S. Tennis Association, along with lists of certified tennis court builders and award winning tennis courts from past years. Numerous design and layout drawings are also included, along with Tennis Industry Magazine's maintenance planner. Sources of information and a glossary of terms conclude the manual. (GR)

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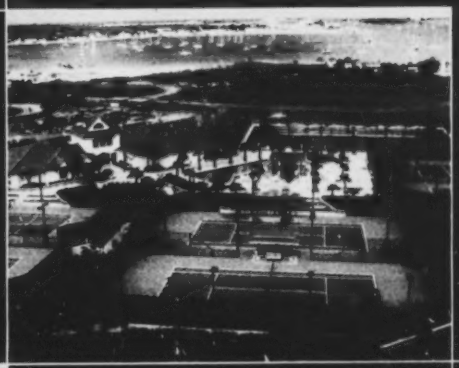

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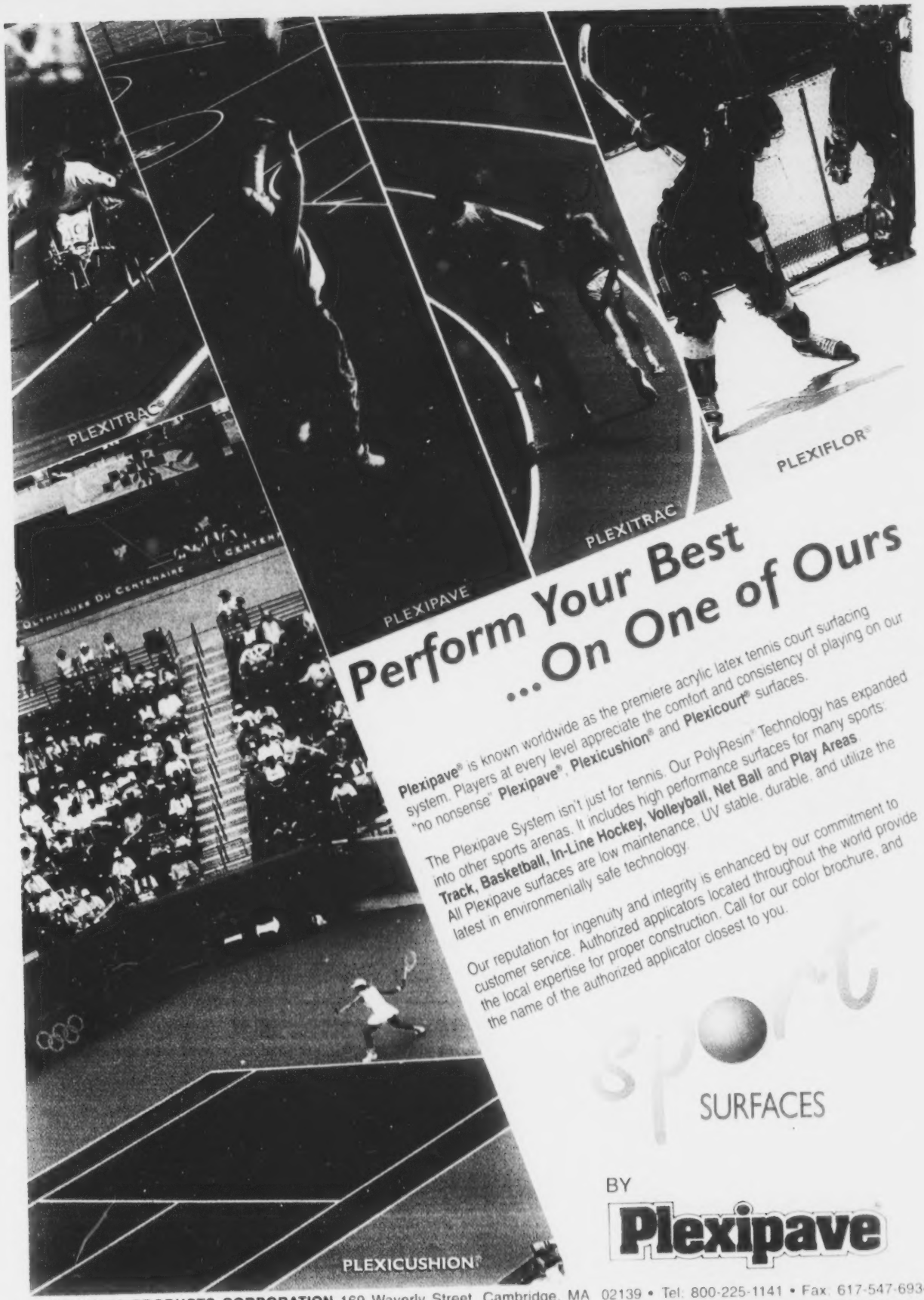

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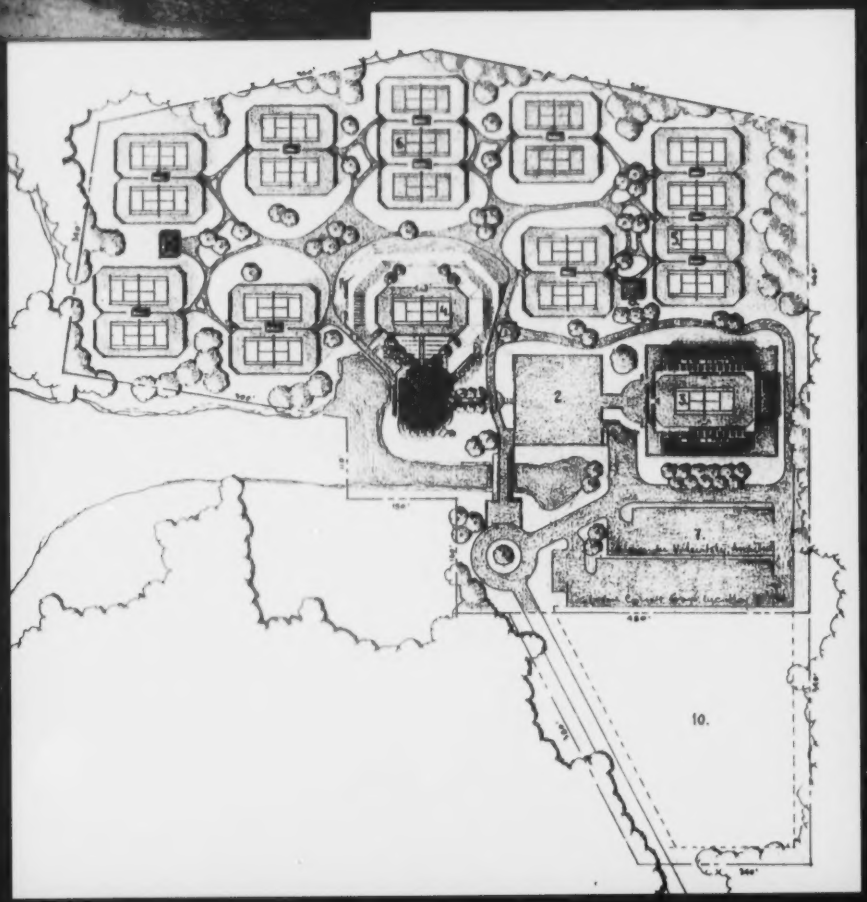
Chapter 1

Getting Started



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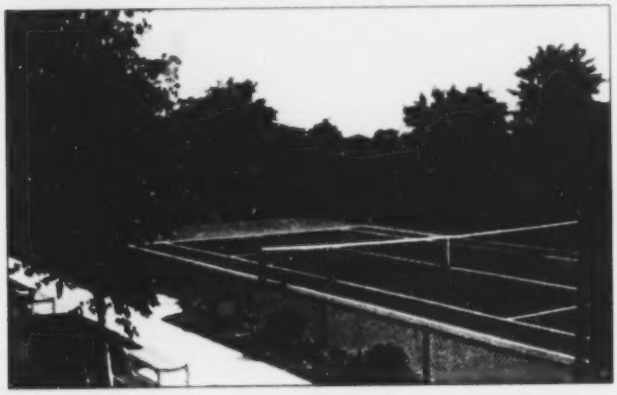
Getting Started

The first step in any tennis facility project is planning. Planning involves a number of steps including defining the project, setting a budget, choosing a suitable site, developing a site plan, selecting a surface or surfaces, developing specifications and so forth. Even more important, effective planning involves planning for the game of tennis. Player preferences must be considered; tennis programming needs must be incorporated. In short, it is important to consider how the tennis facility will foster and enhance the player experience.



This beautifully landscaped court uses fencing custom-designed for the site. Three foot fencing on the near side, allows spectators to view play on the court, while 10' fencing on the far side prevents balls from straying onto adjacent property. Black vinyl-coated fencing and black windscreens provide a good background for play, while helping the court blend into its surroundings. PHOTO COURTESY OF NOVA SPORTS, U.S.A.

Planning decisions are critical because the investment in a tennis facility — whether a single residential court or a multi-court project — is substantial. If properly maintained, well-planned and well-constructed, courts which appeal to players and enhance programming will provide years of playing enjoyment.

The Planning Team

Well-planned courts often depend on a good planning team. Depending on the size and scope of the project, an owner may involve a tennis facility consultant, a design professional such as an architect, civil engineer or landscape architect, an experienced contractor, an experienced facility manager and, perhaps, manufacturers and suppliers of goods and materials including surfacing material, fencing and lighting equipment. These experts can help develop detailed and accurate specifications, suggest options and solve problems.

Equally important is the involvement of facility users and maintenance personnel. For residential courts, all players in the family should be involved. For school courts, the tennis coach should participate. For club, resort or

community tennis facilities, the tennis professional who will plan programming and the players who will use the planned facilities should be involved. Users can contribute vital information about player preferences, programming needs, and accessories and amenities which will make the facility user-friendly. Involving personnel who will ultimately be responsible for maintaining the facility is also beneficial in that they can help ensure that the facility will operate smoothly on a day-to-day basis.

For facilities which are being developed or adapted for tournament use, it is especially important to consult with the appropriate sanctioning organizations, such as USTA, ATP, WTA, etc. Additionally, if the event is to be televised, it would be wise to consult with the media group covering the event. Most tournament events have unique requirements. Typically, issues such as lighting, court sizes (specifically the size of player overrun areas and back court areas), utility requirements, player, official and spectator support facilities will need to be specifically addressed.

Design/Build Projects

For many projects, design/build may be a cost-effective option. In fact, it is becoming more common for tennis court projects to be constructed as design/build projects. In a design/build project, the owner works with an expert contractor, or contractor/designer team, who both designs and builds the project. Not only can a design/build contractor help an owner by formulating and implementing project plans and solving problems, he or she can provide invaluable expertise about local building requirements, available materials, and workable options. Ultimately, the purpose of the design/build alternative is to streamline the design and construction process, saving time and cost to the owner.

However, a design/build contractor or team must be carefully chosen. Extensive, current experience in tennis facilities is a prerequisite. Also, because of the cooperative nature of the owner/builder working relationship in such projects, it is important that the parties work well together, have a similar vision of the facility being planned and communicate effectively. Even when the ideal design/build team is identified, the input of a tennis consultant is worthwhile and a licensed surveyor, landscape architect or professional engineer may be needed to prepare plans and other documents for permitting. For information on locating a qualified design/build contractor or establishing a design/build team, see Chapter III.

Design/Bid Projects

More complex projects are generally built using the design/bid process. This most often involves larger planning teams who work with the owner to devise a facilities plan, prepare construction drawings and specifications, and then put the project out to bid for construction by qualified contractors. More complex projects include multi-court projects, multi-use projects, competition facilities and those involving difficult or unique sites or special needs. Consultants or design professionals are particularly helpful in site planning to insure that courts, walkways, seating and other elements of the facility are laid out in such a way as to make optimal use of the site. Consultants and design professionals also are knowledgeable in such areas as parking and vehicular traffic design, grading and drainage considerations, building selection and location, lighting for specific purposes, such as televised competition, or meeting code and regulatory requirements.

Designers and Consultants

Depending on the scope of the project, employing the services of an expert can help control job costs by better translating the needs of the owner into proper direction for construction, and by helping to avoid costly mistakes. An

architect, professional engineer, landscape architect or tennis court consultant can help an owner identify needs and refine the information to the specific conformation and characteristics of the site. An expert can assist in defining the scope of work to be included in the job, in planning the facility, in determining a realistic budget for the project, in evaluating and comparing bids, in overseeing the work in progress and in solving any problems that occur during construction.

In employing professional assistance, however, it is important to employ an individual or firm with extensive current experience in the field of tennis court planning and construction. To find a qualified expert, an owner may contact professional associations such as the U.S. Tennis Court & Track Builders Association (USTC&TBA), the American Society of Landscape Architects (ASLA), the American Institute of Architects (AIA) and the National Society of Professional Engineers (NSPE). The reference section of this book includes addresses of these organizations. Another way to find a qualified professional is by contacting colleagues who have recently completed similar projects and asking for a recommendation. Many of the recommendations on finding a qualified contractor found in Chapter III also apply to finding a qualified design professional.

Planning

Each tennis facility project is unique. In planning a tennis facility, the following factors should be considered. Many of these factors will be addressed in more detail in other chapters of this book.

Intended Use

Tennis facilities can be used for recreational/social play, for teaching, for league play, for competitive play including tournaments, or for a combination of these purposes. Intended use of courts affects such factors as the number of courts, the layout of multiple courts, the need for accessories and amenities, the appropriate surfaces and the number of courts of each surface.

Facility Concept

Like facilities planned for a private residence or for a tennis club, those to be constructed for a school or other institution should feature quality courts, but budgets, purchasing regulations, surface choices, layout, landscaping, accessories and amenities included will likely be somewhat different. The goal should be to plan the most usable, playable courts possible. From the outside, all quality courts, regardless of budget, location or intended use, should be attractive, accessible and appealing; on the inside, courts should play well and allow players to see the ball and to concentrate on the game.

Player Population

Player factors include the number of players to be accommodated, their ages, their styles of play, their frequency of play and their preferred surfaces.

Initial and Long Term Funding

The amount of funding available will affect the type and number of courts to be built and the accessories and amenities to be included in the project. Less obvious in planning are long term costs such as accessories and amenities to be added later, as well as short and long term maintenance costs. For example, it may be less expensive to

include electrical conduit for future installation of lighting during initial construction than to add it later.

Geographic Considerations

Local climate affects both construction and use of tennis facilities. The depth of subbase construction and footings, the orientation of courts, the availability of materials, the need for certain amenities such as shade shelters or lighting, and other factors will be influenced. Additionally, construction in many regions is regulated with regard to snow loads, wind loads, seismic tolerances, water consumption, energy usage and fire hazards. These regulations are often the result of specific climatic or environmental needs and can significantly impact the design and construction of a tennis facility project.

Maintenance and Security

The location of courts and whether they are staffed and maintained on a daily basis may affect the suitability of certain surfaces. The likelihood of misuse or abuse of courts will affect surface choices, fencing considerations, landscaping and appropriate accessories and amenities.

Scope of the Project

The definition of a project involves not only determining the number and location of the courts, but also defining the additional facilities to be included in the project: lighting, player and spectator seating, a pro shop, club house, dressing rooms and/or rest rooms, offices, parking, refreshment stands or dining areas, exercise and other recreational areas, and maintenance facilities to be included. Work to be completed during initial construction should be considered, as should plans for future upgrading and expansion.

Once the project has been defined, two critical decisions follow: choosing a site and choosing a surface. For more information on site considerations, see Chapter II; for information on surfacing options, see Chapter IV.

A good tennis facility begins with a well-defined concept, a considered site plan, a suitable site on which a well-built base can be constructed and a quality surface, but it doesn't end there. Tennis court accessories must be chosen. Next, an owner must focus on amenities and plan for maintenance. Accessories and amenities are addressed in Chapter V. Maintenance plans and equipment are addressed in Chapter VII.

Finally, landscaping and aesthetics should be considered in the design phase as well. The overall character of the site and the surrounding areas should be considered. Ideally, a tennis facility should be designed and constructed in such a way as to harmonize with its surroundings. The careful selection of building materials, architectural elements, and the arrangement of facilities on the site can help a tennis facility to blend well into its surroundings. Trees, shrubs and other plantings, access paths, retaining walls, wind and background screens should be situated to give players and spectators a pleasant effect when playing or watching matches.

Budgeting

Developing a budget may be the most difficult step in the construction process. In order to make informed decisions, an owner should have a clear sense of priorities. Working within a budget involves considering various alternatives and making choices. A knowledge of what factors are most important to the planned facility and a desire to seek creative solutions can result in a quality project built at a reasonable cost.

The budget should include sufficient funding for some or all of the following:

- Feasibility study;
- Site acquisition;
- Planning and design;
- Permitting;
- Site investigation;
- Site preparation;
- Site drainage and grading;
- Site utilities;
- Court construction:
    - Base construction;
    - Surface construction;
- Fencing;
- Court and site lighting;
- Construction of related facilities (service buildings, parking, seating, pro shop/clubhouse, etc.);
- Accessories and amenities;
- Landscaping, walkways; and
- Operations.

Other than the scope of the project (number of courts, related structures and facilities, etc.) and the choice of a surface or surfaces, one of the most important factors in meeting a reasonable budget is the site chosen for the facility. Site factors, including permitting requirements, water management considerations, excavation and fill needs, access and the availability of utilities, can be budget breakers. Site factors are addressed in more detail in Chapter II. A design professional, tennis court consultant or experienced contractor can help the owner identify such factors and anticipate the impact on the facility budget.

Because planning and developing a tennis facility is a complex process, owners are cautioned not to purchase a site until the following issues have been preliminarily addressed:

- demographics;
- financial feasibility; and
- construction feasibility.

Rather than delaying a project, careful advance consideration before purchasing a site can prevent expensive and time-consuming problems and, perhaps, mistakes.

Chapter II

Planning and Design Considerations

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Planning and Design Considerations

Playing by the Rules

All courts, whether public or private, for recreational play or for competition, must be built according to the rules promulgated by the International Tennis Federation. The following rules are from *Rules of Tennis*, published periodically by the International Tennis Federation in London, England, of which the United States Tennis Association (USTA) is a member. They are used with permission. When a match is played in the United States, USTA comments have the same weight as do the rules.

Rule 1 - The Court

The Court shall be a rectangle 78 feet (23.77m) long and 27 feet (8.23m) wide.

USTA Comment: *See Rule 34 for a doubles court.*

It shall be divided across the middle by a net suspended from a cord or metal cable of a maximum diameter of one-third of an inch (0.8cm), the ends of which shall be attached to, or pass over, the tops of the two posts, which shall be not more than 6 inches (15cm) square or 6 inches (15cm) in diameter. These posts shall not be higher than 1 inch (2.5cm) above the top of the net cord. The centers of the posts shall be 3 feet (.914m) outside the Court on each side and the height of the posts shall be such that the top of the cord or metal cable shall be 3 feet 6 inches (1.07m) above the ground.

When a combined doubles (see Rule 34) and singles Court with a doubles net is used for singles, the net must be supported to a height of 3 feet 6 inches (1.07m) by means of two posts, called "singles sticks", which shall be not more than 3 inches (7.5cm) square or 3 inches (7.5cm) in diameter. The centers of the singles sticks shall be 3 feet (.914m) outside the singles Court on each side.

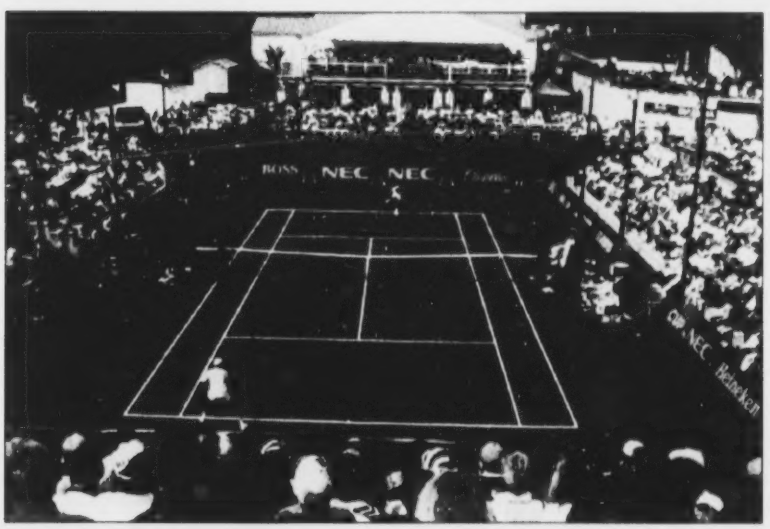
The net shall be extended fully so that it fills completely the space between the two posts and shall be of sufficiently small mesh to prevent the ball passing through. The height of the net shall be 3 feet (.914m) at the center, where it shall be held down taut by a strap not more than 2 inches (5cm) wide and completely white in color. There shall be a band covering the cord or metal cable and the top of the net of not less than 2" (5cm) nor more than 2 1/2" (6.35cm) in depth on each side and completely white in color. There shall be no advertisement on the net, strap band or singles sticks.

The lines bounding the ends and sides of the Court shall respectively be called the baselines and the sidelines. On each side of the net, at a distance of 21 feet (6.40m) from it and parallel with it, shall be drawn the service-lines. The space on each side of the net between the service-line and the sidelines shall be divided into two equal parts called the service-courts by the center service-line, which must be 2 inches (5cm) in width, drawn half-way between, and parallel with, the sideline. Each baseline shall be bisected by an imaginary continuation of the center service-line to a line 4 inches (10cm) in length and 2 inches (5cm) in width called "the center mark" drawn inside the Court, at right angles to and in contact with such baselines. All other lines shall be not less than 1 inch (2.5cm) nor more than 2 inches (5cm) in width, except the baseline which may be not more than 4 inches (10cm) in width, and all measurements shall be made to the outside of the lines. All lines shall be of uniform color. If advertising or any other material is placed at the back of the Court, it may not contain white or yellow. A light color may only be used if this does not interfere with the vision of the players.

If advertisements are placed on the chairs of the linesmen sitting at the back of the court, they may not contain white or yellow. A light color may only be used if this does not interfere with the vision of the players.

Note 1: *In Davis Cup, Fed Cup and the Official Championships of the International Tennis Federation, specific requirements with regard to the space behind the baseline and at the sides are included in the respective regulations for these events.*

Note 2: *At club or recreational level, the space behind each baseline should be not less than 18 feet (5.5m) and at the sides not less than 10 feet (3.05m).*



This stadium court includes light fixtures and spectator seating. Additionally, it offers ample space for officials. Photo courtesy of Plexipave System Tennis Courts.

Rule 2 - Permanent Fixtures

The permanent fixtures of the Court shall include not only the net, posts, singles sticks, cord or metal cable, strap and band, but also, where there are any such, the back and side stops, the stands, fixed or movable seats and chairs round the Court, and their occupants, all other fixtures around and above the Court, and the Umpire, Net-cord Judge, Footfault Judge, Linesmen and Ball Boys when in their respective places.

Note: *For the purpose of this Rule, the word "Umpire" comprehends the Umpire, the persons entitled to a seat on the Court, and all those persons designated to assist the Umpire in the conduct of a match.*

Rule 34 - The Doubles Court

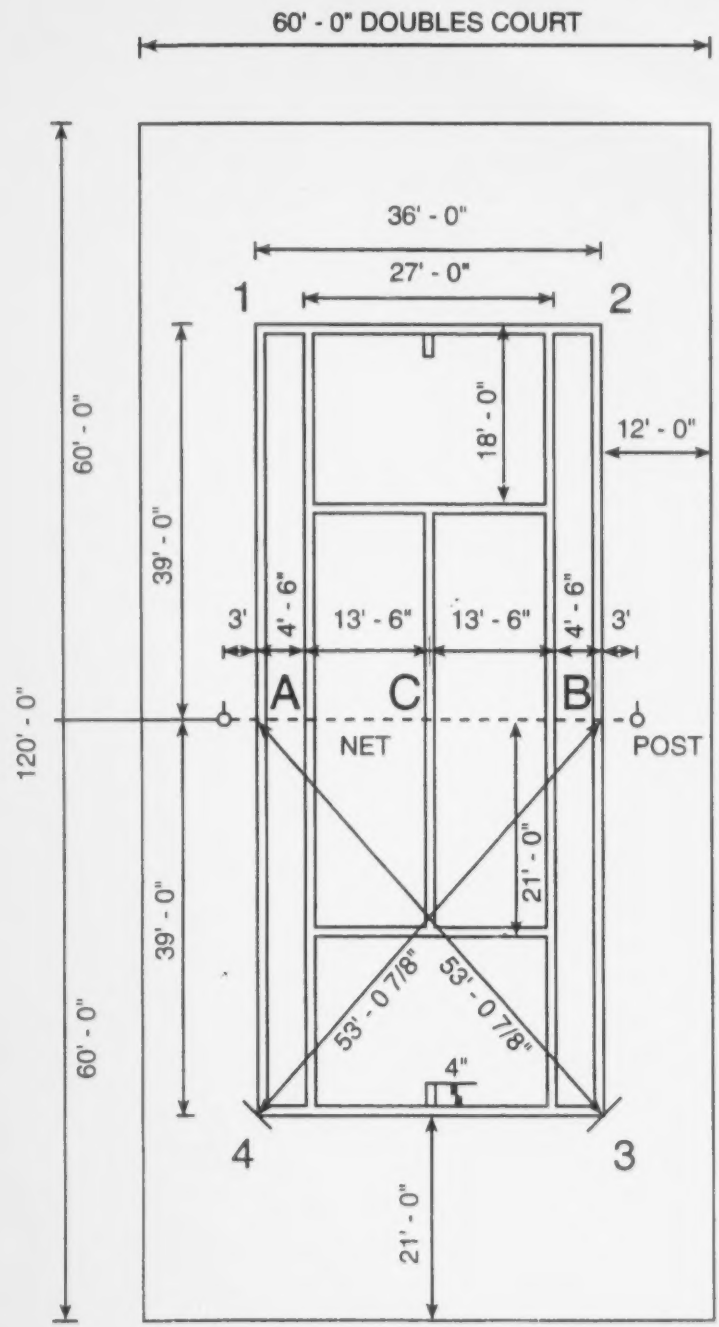
For the Doubles Game, the Court shall be 36 feet (10.97m) in width, i.e., 4 1/2 feet (1.37m) wider on each side than the Court for the Singles Game, and those portions of the singles sidelines which lie between the two service-lines shall be called the service sidelines. In other respects, the Court shall be similar to that described in Rule 1, but the portions of the singles sidelines between the baseline and the service-line on each side of the net may be omitted if desired.[1]

USTA Comment: *The Server has the right in doubles to stand anywhere back of the baseline between the center mark imaginary extension and the doubles sideline imaginary extension.*

Suggestions on How to Establish Playing Lines

1. In laying out court dimensions, first establish the center line between the net posts and locate the center point, C. Locate points A and B, 18' on either side of Point C.
2. From Point A, swing an arc 39' to Points 1 and 4. From Point A swing an arc 53' 7/8" to Points 2 and 3.
3. From Point B, swing an arc 39' to Points 2 and 3. From Point B, swing an arc 53' 7/8" to Points 1 and 4.
4. The points formed by the crossing of the arcs at 1, 2, 3 and 4 are the outside corners of the playing lines for a doubles court.
5. From these points, the side lines, baselines and the interior lines can be established according to standard tennis court dimensions. (See diagram)
6. Note: All measurements are to the outside of the playing lines except for the center service line and the center mark.
7. Note: All lines shall be a minimum of 1" and a maximum of 2" in width, except the baseline which may be up to 4" in width, and the center service line which shall be 2" in width.
8. As a means of checking the accuracy of the lines, the distance from Point 1 to Point 2 and from Point 3 to Point 4 should be exactly 36' and the distance from Point 1 to Point 3 and from Point 2 to Point 4 should be 85' 11".

1 Rules of Tennis 1998 The International Tennis Federation, London, England, 1998.



ESTABLISHING PLAYING LINES

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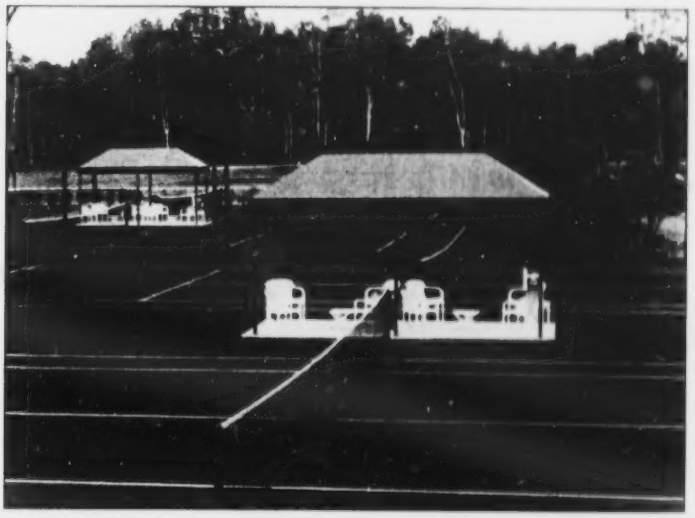
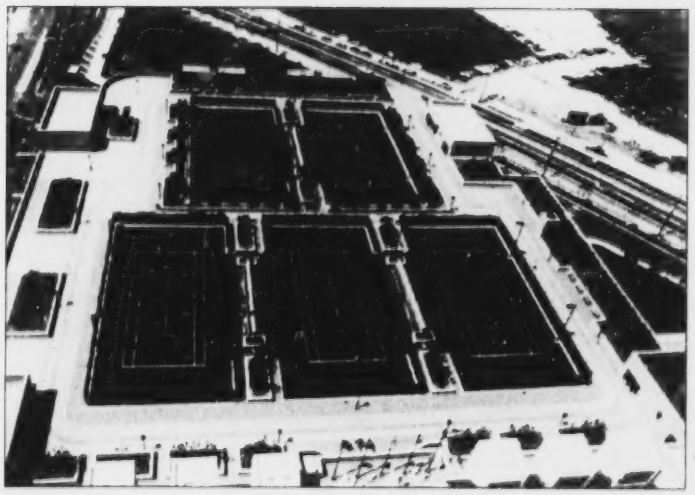
Number of Courts

In planning tennis facilities, the question of how many courts to build is important. Studies indicate that facilities should be planned based on the number of players within 6 miles or 15-20 minutes driving time from the site. Consider the population within that radius.



This battery of four fast-dry courts shows offset placement of courts and shaded areas for spectators. Note the non-traditional fencing, designed to retain balls without creating the 'caged-in' atmosphere produced by all-around 10' fencing. PHOTO COURTESY OF LEE TENNIS PRODUCTS AND WELCH TENNIS COURTS, INC.



This five-court rooftop facility is situated with enough distance between the fence and the edge of the building to minimize the possibility of stray balls which might escape the top of the fence. It also offers areas for spectators to watch the action on court, or for players to rest after a match. PHOTO COURTESY OF JULICHER SPORTS.

According to the USTA, the following number of public and private courts is needed for markets of various sizes:

POPULATION	NUMBER OF COURTS
15,000	20
25,000	30
50,000	50
100,000	80
250,000	130
500,000	210
750,000	270
1,000,000	320
1,250,000	360
1,500,000	400
More than 1,500,000	1 per 4,000[2]

These figures are recommended averages. In large cities, each section should be considered as a separate community.

In planning indoor tennis facilities, again consider the number of players within 15 to 20 minutes driving time from the facility. A good "rule of thumb" is that most markets can support one indoor tennis court for every 10,000 people. Depending on programming, each indoor court, if open for 15 hours a day, can support the needs of approximately 150 players.

Court usage should be calculated based upon operating hours. For example, 30 groups of doubles players (30 x 4 = 120 players) playing 1 1/2 hours at a time twice a week (3 hours/wk), use 90 hours per week (30 x 3 = 90). A three court facility open from 6:00 a.m. until 10:00 p.m. seven days per week has 336 available court hours per week (3 x 16 x 7 = 336). Therefore, 30 groups of doubles players use over 25% of the capacity of that facility (90/336 = 26.7%).

When determining the number of courts to build, consider also how many of the existing courts in the community are public and how many are private, how many are indoor and how many are outdoor, how many outdoor courts are lighted and how many of the existing courts are of various surfaces. The popularity of tennis in the community, the average age and the average income of the population and the number of tourists which visit the community will increase or decrease the number of courts needed as well.

The number of courts needed depends not only on the number of players, but also on the number of times per week they play and whether they play singles or doubles. A serious player may play 3-4 hours or more per week, as much as or more than four occasional players. Similarly, singles players use twice as much court time as doubles players. For private tennis clubs frequented by serious players, one outdoor court will support 20 to 40 tennis players. For school courts, one court for 200 to 300 students may be adequate. For community tennis, the number of courts needed varies widely.

The degree of commitment to tennis programming may increase or decrease the number of courts needed. The more leagues, lessons, tournaments, etc. to be scheduled, the more courts will be needed. In fact, intended use of courts (league play, tournaments, instruction, recreation) affects the number of courts needed, the number of courts in each surface and the layout of courts.

Another factor which affects the number of courts needed is climate, which determines the length of the playing season for outdoor courts and the need for indoor courts. For outdoor courts, the length of the playing day is important; lighting will extend the playing day. To make the most of every available hour, whether outdoors or indoors, time reservations for courts will increase efficiency of scheduling play.

2 Tennis Courts 1992-1993, United States Tennis Association, 1992, 1996, pg. 15. Reprinted with

For a large project or for community tennis planning, a feasibility study conducted by a tennis consultant may help to identify, quantify and analyze demographic factors to determine the appropriate number of courts. Such a study also will include an evaluation of the proposed location including size, shape, zoning, access, cost, topography, soil borings, relation to market, available utilities, allowance for expansion, parking, landscaping, etc. The report will estimate the costs of facility design, land, utilities, construction and landscaping as well as income and operating expenses for the first three years of operation. In drafting a report, the consultant will consider the population, average age and family income, competing tennis facilities and existing interest. Finally, he or she will give an opinion as to whether or not the project would be successful if properly promoted and managed. The cost of such a study will ordinarily be a percentage of the proposed cost of the facility. The existence of a feasibility study with a positive outcome may make financing easier, especially if the study suggests alternative uses for the planned facility.

Site Requirements

The size and scope of the tennis facility that can be built obviously depend on the size of the site available. Even more important, the ultimate performance of any tennis court depends to a considerable degree on site characteristics such as the nature of the subsoil and drainage conditions. For these reasons, choosing a site is an extremely important step in developing a successful facility and can eliminate many of the problems associated with construction. In many cases, however, the site is predetermined. Often in school, resort and club projects, the site set aside for the tennis courts is a site not suitable for construction of buildings, meaning a site with poor grade, poor soil characteristics or drainage problems.

Topography, drainage (surface and subsurface), soil conditions, access, orientation, availability of utilities and site restrictions, all must be considered in choosing a site.

At a minimum, a suitable site should meet the following requirements:

- For an individual tennis court, the playing line dimensions are 36' (10.973m) X 78' (23.774m) for doubles, 27' (8.230m) X 78' (23.774m) for singles. An overall court size of at least 60' (18.288m) X 120' (36.576m) is strongly recommended for an individual court. However, since vegetation should be removed for a minimum of 5' (1.524m) around the site and since drainage should be installed and the contractor must have room to work, the proposed site should be larger than the finished court. A minimum site size of 70' (21.336m) X 130' (39.624m) is recommended; a site of 80' (24.384m) X 140' (42.672m) is preferred.

- Compactible soil is preferred. Examples of compactible soil include sand and gravel, sandy loam or a mixture of sand and clay.

- The ground should be reasonably level, on the same plane or, preferably, 4" (102mm) to 6" (152mm) higher than adjacent land to allow drainage away from the courts.

- The site should be sheltered from prevailing winds, away from traffic noise, playgrounds, pools and other distractions, and devoid of shadows cast by buildings or trees.

- A dark, solid background is desirable. Light backgrounds, such as white buildings, or moving backgrounds, such as people or traffic, should be avoided at the ends of the court. Landscaping or background curtains can be used to screen out inappropriate backgrounds.

These and other site factors are addressed in more detail in this chapter.

Size

The outside dimensions of the playing lines are 36' (10.973m) X 78' (23.774m) for doubles, 27' (8.230m) X 78' (23.774m) for singles. An overall court area of at least 60' (18.288m) X 120' (36.576m) is strongly recommended for an individual court. Where space is limited, the minimum overall dimensions which are acceptable for play are 56' (17.069m) X 114' (34.747m) according to ITF rules. Where additional space is available, a hard surface pavement of 62' (18.898m) X 122' (37.186m) allows the contractor to install fencing one foot (305mm) inside the edge of the pavement which facilitates maintenance. For soft courts, the curbing can be constructed at 60' (18.288m) X 120' (36.576m) and the fencing can be placed directly outside the curb. For tournament play where judges are required, a clear area of 66' (20.117m) X 132' (40.234m) is recommended, providing a clear playing area of 60' (18.288m) X 120' (36.576m) with additional area for the judges and safe overrun area for the players. In constructing tournament courts, it is important to consult the sanctioning body since requirements for judges, player overrun areas and press vary from organization to organization and are constantly changing.

Stadium courts for tournament play require a back space (the measurement from the baseline to a fixed obstruction such as a backstop, wall or fence) of 27' (8.230m) and non-stadium tournament play requires 21' (6.401m). A distance of 18' (5.486m) is considered minimum.

Not less than 12' (3.658m) from the sideline to a fixed obstruction (sidestop, light pole, wall or fence) is recommended.

For a battery of courts within a common enclosure, a 24' (7.315m) separation between courts is recommended, while 12' (3.658m) is considered the absolute minimum, although some older courts were constructed with less. A 24' (7.315m) separation provides sufficient space for a shade structure or player seating/storage between courts, as well as for a safe overrun area for the players. A 24' separation between courts in a battery also permits installation of divider fences to prevent balls from rolling onto adjacent courts. Since divider fences are considered fixed obstructions, they should be at least 12' (3.658m) from the sidelines of each court and, therefore, a 24' (7.315m) separation is required for their installation. For indoor courts where movable netting is used between courts, a minimum of 18' (5.486m) between courts is recommended. Divider netting is not considered a fixed obstruction.

The space directly over the court should be free of overhanging limbs or any other overhead obstructions for outside play, and should be not less than 18' (5.486m) at the fence, 21' (6.401m) over the baseline and 35' (10.668m) over the net, although 38' (11.582m) is recommended.

Of course, the size of the site necessary for a tennis facility depends on the number of courts to be built, the layout of the courts (individual courts, batteries of two or more), additional facilities included in the project (spectator seating, locker rooms, pro shop, parking, etc.), the type and amount of landscaping planned and other factors. Tennis consultants and landscape architects are particularly adept at planning optimum use of a site.

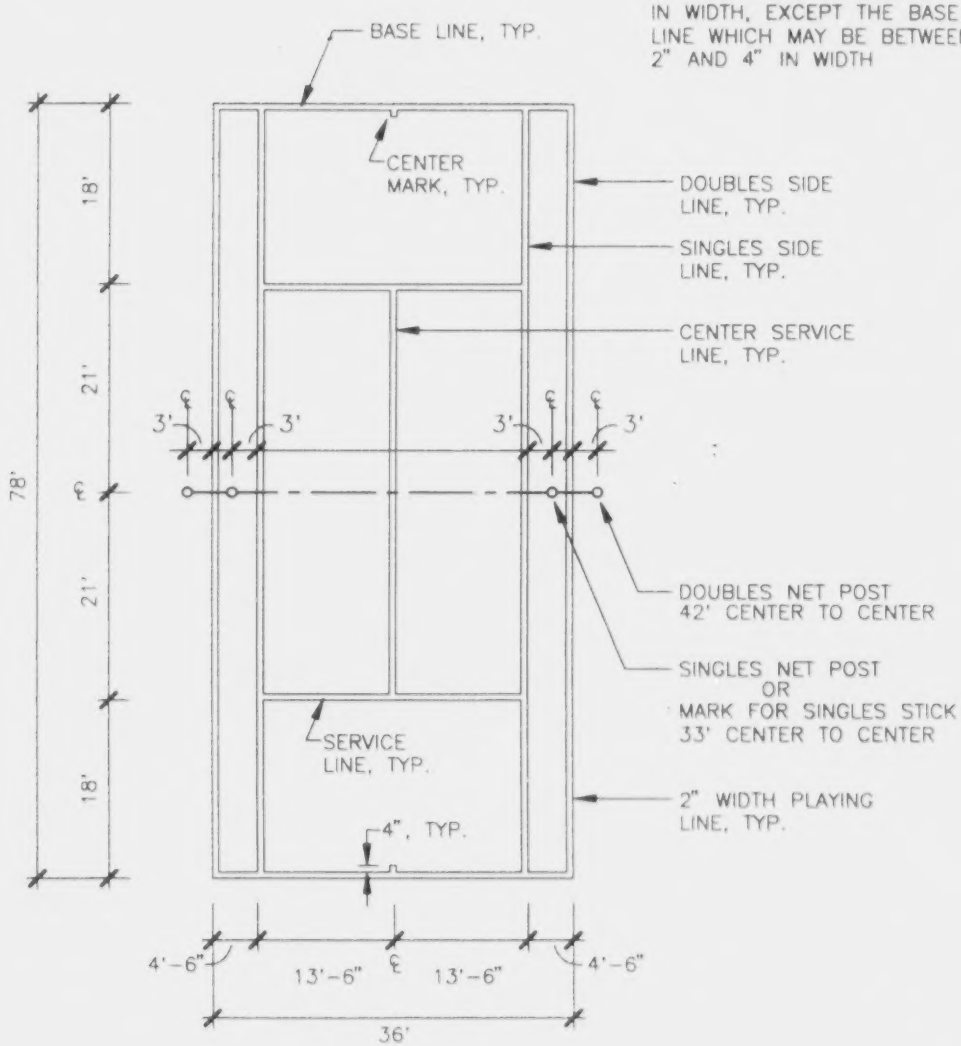
Soil Conditions

In tennis court construction, proper grading and consistent compaction often determine the success of the installation. To achieve proper grading and consistent compaction, appropriate subbase conditions are required.

Most sites will require subsoil site investigation. The only exceptions are sites where the owner, contractor or consultant is very familiar with soil and subsoil conditions, ground water and drainage in the area. Farmers, pavers or excavators in the area often can provide information regarding soil and subsoil conditions. County soil survey

NOTES:
ALL DIMENSIONS ARE TO THE OUTSIDE EDGE OF LINES.

ALL PLAYING LINES ARE 2" IN WIDTH, EXCEPT THE BASE LINE WHICH MAY BE BETWEEN 2" AND 4" IN WIDTH



TENNIS COURT
PLAYING LINE LAYOUT PLAN

NOT TO SCALE

PLINES

U.S. TENNIS COURT AND TRACK BUILDERS ASSOCIATION

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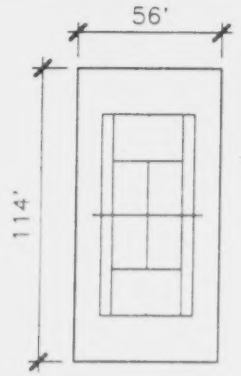
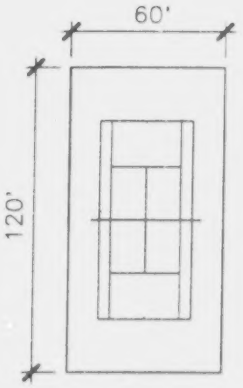
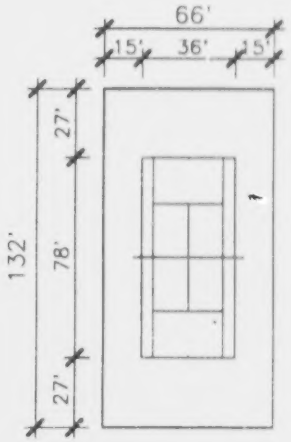


MINIMUM COURT SIZE

(IN ACCORDANCE WITH I.T.F REGULATIONS–NOT RECOMMENDED)



RECOMMENDED
MINIMUM COURT SIZE



STADIUM COURT

(AS RECOMMENDED FOR DAVIS CUP WORLD GROUP AND FEDERATION CUP MAIN DRAW EVENTS)

TYPICAL SINGLE COURT LAYOUT PLANS

NOT TO SCALE

LAYOUT–1

U.S. TENNIS COURT AND TRACK BUILDERS ASSOCIATION

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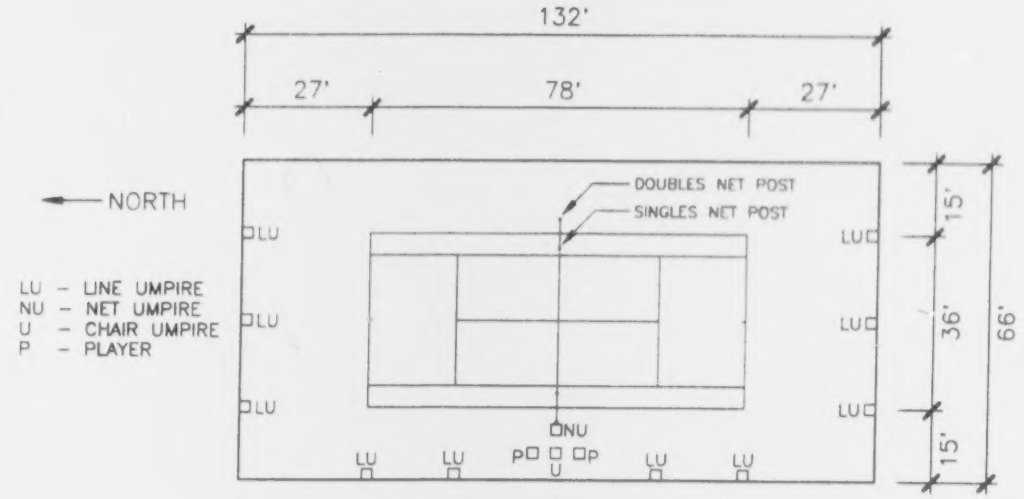
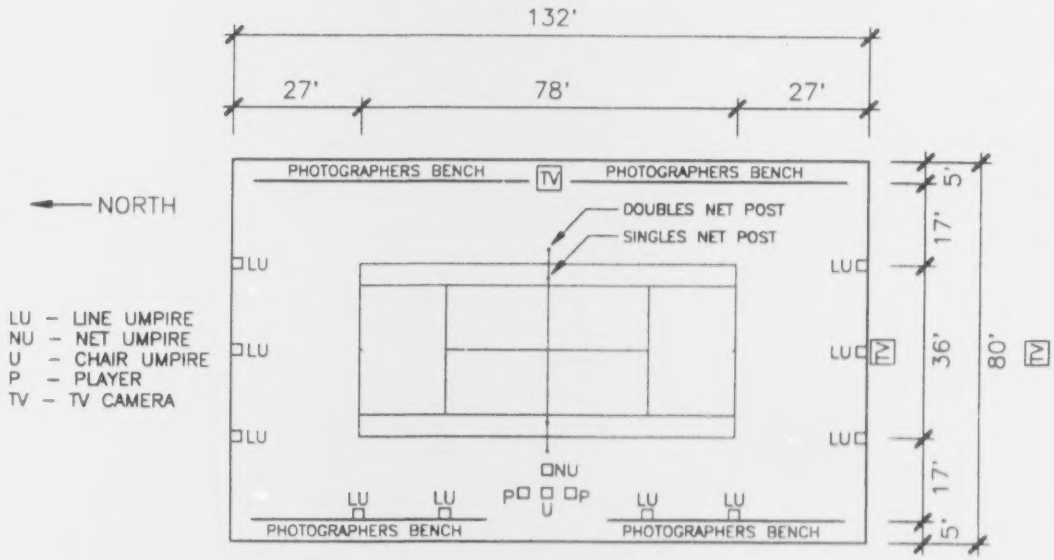


LAYOUT RECOMMENDED FOR
DAVIS CUP WORLD GROUP AND FEDERATION
CUP MAIN DRAW EVENTS



TYPICAL LAYOUT FOR
TELEVISED INTERNATIONAL COMPETITION

TYPICAL STADIUM COURT LAYOUT PLANS

NOT TO SCALE

STADIUM

U S TENNIS COURT AND TRACK BUILDERS ASSOCIATION

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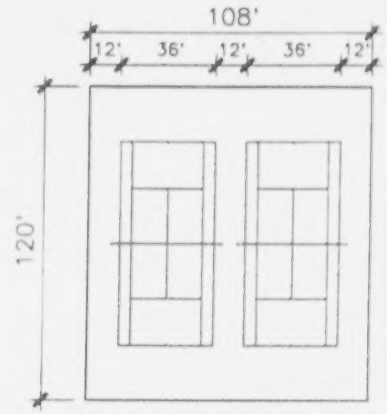

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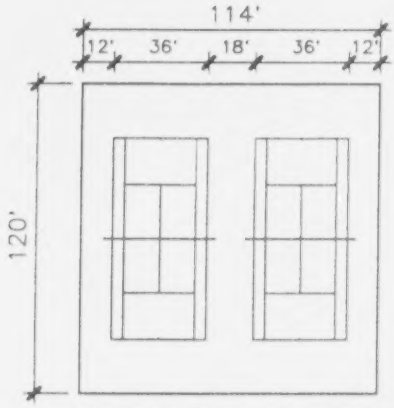
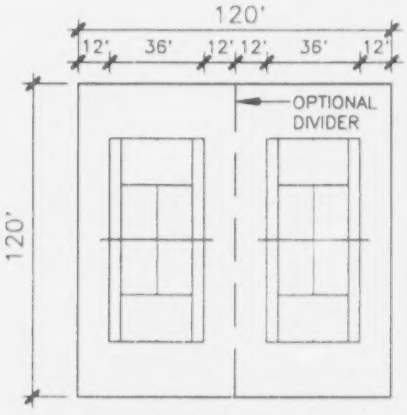


PREFERRED MINIMUM SIZE



FULL SIZE (RECOMMENDED)

TYPICAL 2 COURT BATTERY LAYOUTS

NOT TO SCALE

LAYOUT-2

U.S. TENNIS COURT AND TRACK BUILDERS ASSOCIATION

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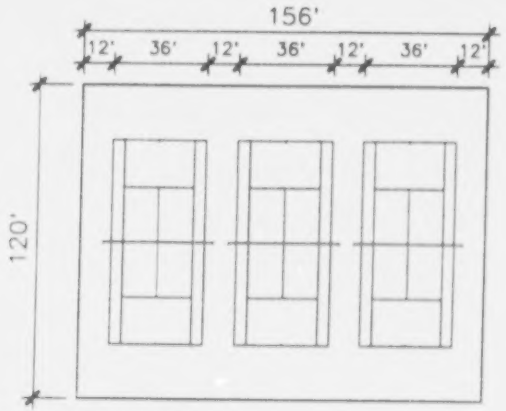

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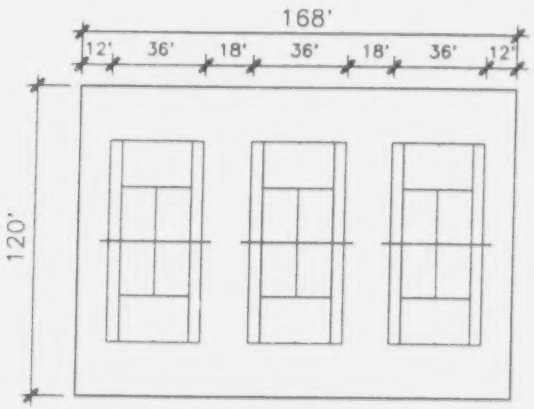

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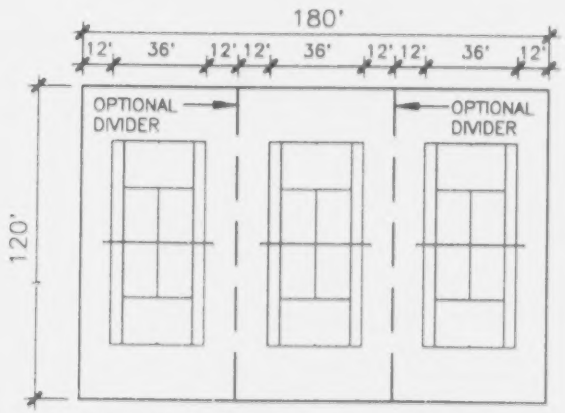

FULL SIZE (RECOMMEMDED)

TYPICAL 3 COURT BATTERY LAYOUTS

NOT TO SCALE

LAYOUT-3

U.S. TENNIS COURT AND TRACK BUILDERS ASSOCIATION

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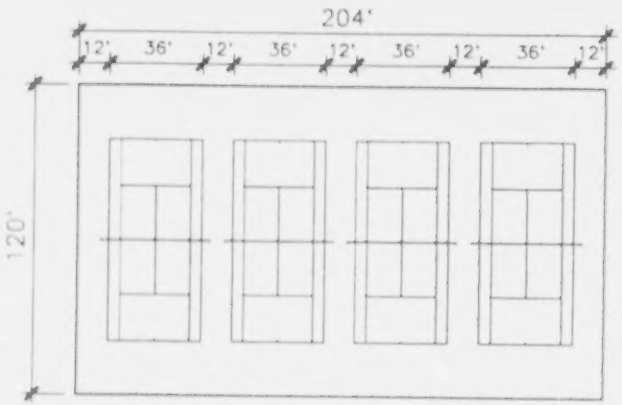

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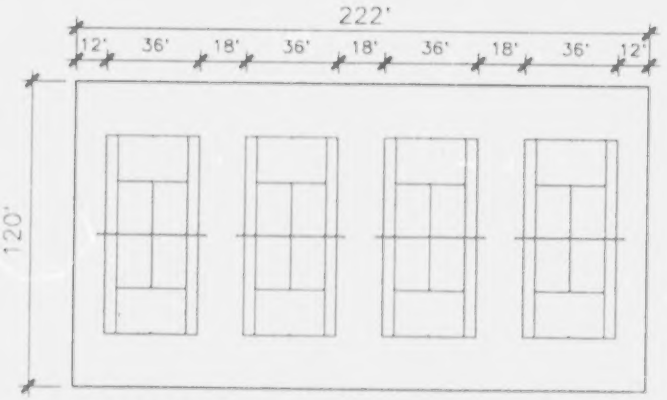

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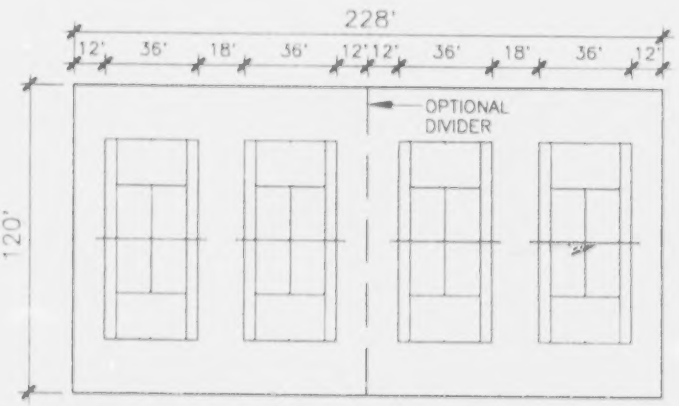

PAIRED TWO COURT BATTERY (RECOMMENDED SIZE)

TYPICAL 4 COURT BATTERY LAYOUTS

NOT TO SCALE

LAYOUT-4

U.S. TENNIS COURT AND TRACK BUILDERS ASSOCIATION

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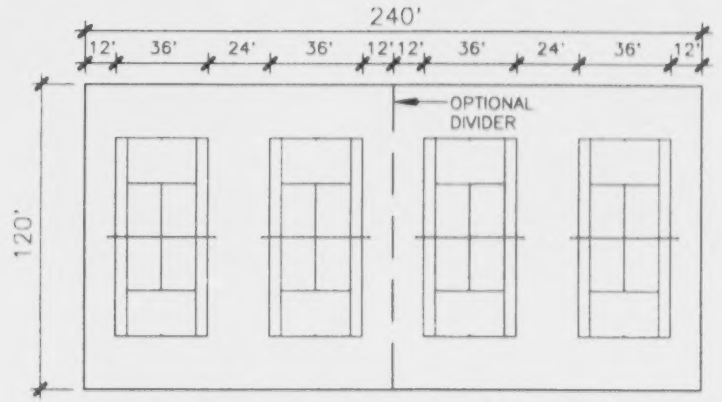

PAIRED TWO COURT BATTERY (RECOMMENDED SIZE)

TYPICAL 4 COURT BATTERY LAYOUT

NOT TO SCALE

LAYOUT-5

U.S. TENNIS COURT AND TRACK BUILDERS ASSOCIATION

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reports, available from local offices of the Department of Agriculture or cooperative extension agents, also can provide information on the properties of natural soils in given locations. Soil borings taken and evaluated by a geotechnical engineer are recommended, however, in most situations.

Where no soil problems are suspected, shallow hand dug test pits or backhoe excavation often can provide sufficient information to determine whether or not a particular site is suitable. Such investigations not only help to determine whether a site is suitable, but also provide information with regard to topsoil removal, requirements for excavation and/or fill and water management needs.

One simple way to examine the soil is to dig a hole with a post hole digger to a depth of approximately 5' (1.524m). Examine the soil as it comes out of the hole, noting the types of soils and the depth at which each is encountered.

Sand and gravel, sandy loam and sandy clay, often found in dry lakes or river beds, in arid regions and near the seashore, drain and dry quickly and compact well. These are desirable soils for the construction of tennis facilities.

Peat, humus and loam often are found in forested areas, farm lands and swampy areas. These soils are composed largely of decaying organic materials. They are difficult to compact; they absorb water, which makes them subject to freeze-thaw; and they often settle as decomposition continues. Organic soils will likely need to be removed and replaced by a more stable base.

Clay is extremely hard when dry, expands and becomes gummy when wet, and is subject to freeze-thaw action. Clay, too, may need to be removed and replaced, depending on the surface chosen and local climatic conditions.

Once the soils are identified, notice if and when water begins to weep into the hole. If water weeps into the hole, wait until the water level evens off. That is the level of the current water table. Of course, the water level may depend upon the time of year such a test is conducted and upon recent weather. A test taken after a long rainy spell or immediately after a substantial snow melt will show a higher water level than one taken after a midsummer drought. For a more accurate measurement of the water table, place a PVC pipe in the hole and measure the water level periodically over time to determine the minimum, maximum and average water table. If standing water is visible regularly in the hole, it may indicate potential problems for a tennis court constructed on that site. A drainage system may need to be constructed to lower the water table in the area of the tennis court.

If the hole is dry, a percolation test may determine the soil's ability to absorb and disperse water. Fill the hole with water and time its dispersal. If the hole is dry after one hour, good subsoil drainage exists. If not, the longer the water takes to disperse, the poorer the natural drainage of the site and the more carefully the drainage system must be designed.

When preliminary excavations are undertaken, they should be carefully backfilled and compacted.

If undesirable soils and/or poor drainage is encountered, more careful soil investigation is suggested. Auger borings should be taken to a depth of at least 5' (1.524m), or until firm materials are encountered. Borings should be taken at the corners of the planned court and between courts in a proposed bank of courts with a maximum of 200' (60.962m) between borings. If problem soil or drainage conditions are suspected or discovered, more frequent or deeper borings are suggested. Compression tests, water content and density determinations are recommended on cohesive soils; penetration resistance and blows per foot are recommended for granular soils. Water level determinations are recommended for all difficult sites. It is also recommended that professional advice be sought. A geotechnical engineer or architect, can examine the findings and make recommendations on design, site preparation and drainage.

Where expansive, non-compactible and poorly drained soils are encountered and cannot be removed and replaced with appropriate fill, asphalt courts are not recommended since these soils constitute an unstable subbase and freeze-thaw action will likely lead to settlement and cracking. If no other site can be used, soft courts or post-tensioned concrete courts are recommended alternatives.

Drainage

A suitable site for tennis facility construction must allow for an appropriate water management system. Establishing proper drainage is probably the single most critical concern in tennis court construction. Therefore, the ideal site for a tennis facility is high and dry. Since the site set aside for a tennis facility is sometimes a site unsuited for construction of another structure, however, water management considerations frequently exist.

Proper surface and subsurface drainage helps to remove water from the courts and, more importantly, redirects water which may flow over or under the court from surrounding areas. In addition, where it is necessary to lower the water table under the court, a subsurface drainage system at the perimeter of the court or courts may be required.

Water, particularly water under the court, causes erosion of the subbase, expansion and contraction, freeze-thaw action and excessive settlement. Rain water falling on the court is a relatively minor concern, though it must be removed and dispersed. Water under and on the court is a primary cause of cracking of the court surface, heaving of fence and net post footings, moisture stripping, bubbling or undulation of the asphalt pavement and delamination of color coating systems. Where poor drainage exists, addition of more base material in construction or continuing repair of the court surface does not eliminate the basic problem which will inevitably lead to surface failure.

Surface Drainage

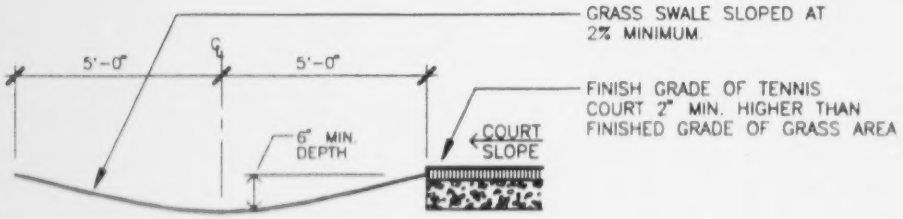
Surface drainage controls removal of above ground storm water resulting from precipitation. There are three types of surface drainage systems: open systems, closed systems and combination systems.

Open systems utilize swales (a natural drainage channel covered with vegetation, usually grass) and gutters (a paved swale) to divert water away from the tennis courts. Open systems rely on slope (gravity) alone to move water away from the court. Lawn swales should be sloped at a minimum of 2% (1:50) to prevent the accumulation of standing water and a maximum of 10% (1:10) in order to avoid erosion.

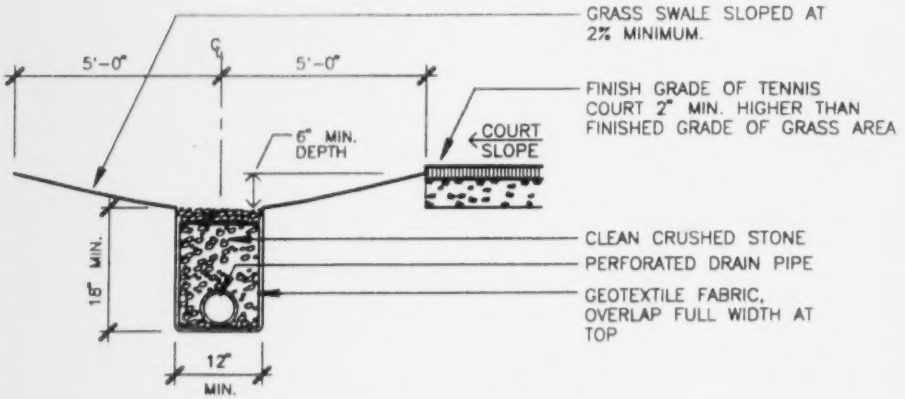
Gutters can be sloped between 1% (1:100) and 50% (1:2). The advantage of an open system is that such a system is fairly inexpensive to build if there is room and the ground is easily workable. Open systems are less practical on sites where space is limited.

Closed drainage systems are made up of pipes linking drainage structures such as trench drains and catch basins. With a closed drainage system, the water is not guided along the surface; rather, it is collected by the structures and diverted away through pipes to a municipal storm water system or to a natural outfall such as a stream or lake. What makes a closed drainage system "closed" is that the water is transported in a contained system.

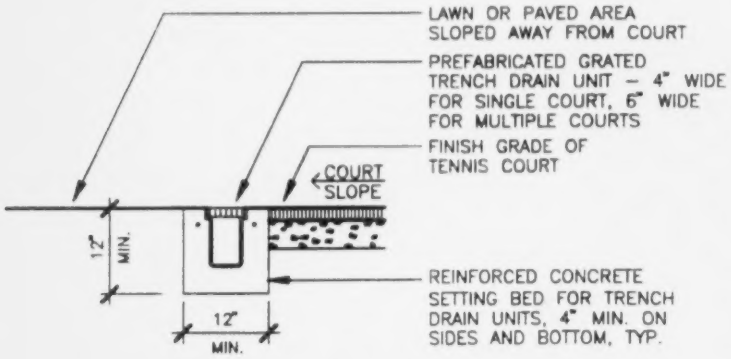
There are two types of trench drains: gravel trench drains and grated trench drains. Gravel trench drains consist of an open trench 12" (305mm) - 24" (610mm) wide with a sloping bottom. The trench is usually lined with a geotextile. Next, a porous pipe is laid along the bottom. The trench is filled with gravel; the geotextile is wrapped over the top and covered with a 2" (51mm) - 4" (102mm) layer of gravel. The gravel surface is open to catch storm water and the pipe at the bottom of the trench collects it and carries it away.



SECTION GRASS DRAINAGE SWALE
AT EDGE OF TENNIS COURT
(OPEN TYPE DRAIN SYSTEM)



SECTION GRAVEL TRENCH DRAIN
AT EDGE OF TENNIS COURT
(COMBINATION TYPE DRAIN SYSTEM)



SECTION GRATED TRENCH DRAIN
AT EDGE OF TENNIS COURT
(CLOSED TYPE DRAIN SYSTEM)

SURFACE DRAINAGE AT COURT EDGES

NOT TO SCALE

DRAIN – 3

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A similar option is a grated trench or channel drain, a type of gutter made of concrete or prefabricated sectional material with a grate on the top to prevent debris from entering.

The advantage of trench drains is that their top surface can be set at a uniform grade, eliminating the need for a sloped swale or gutter. The bottom of the trench slopes instead. This is particularly useful where there is limited area around a court for drainage. In addition, it is quite common to use a gravel trench drain to act as both a surface and subsurface drain.

In reality, most surface drainage systems are made up of a combination of swales, gutters, catch basins and pipes (see below), known as a combination system. The decision as to which system to use depends on cost, area of the site and local governmental requirements. In fact, most local governments require a drainage permit for projects over a specific size. Consultation with a local design professional or with government officials can provide information regarding such requirements.

These systems treat only surface water and may be insufficient if the site is low and a large area of land drains onto it. They are, however, useful to remove water drained off the court or off nearby buildings or pavements.

Subsurface Drainage

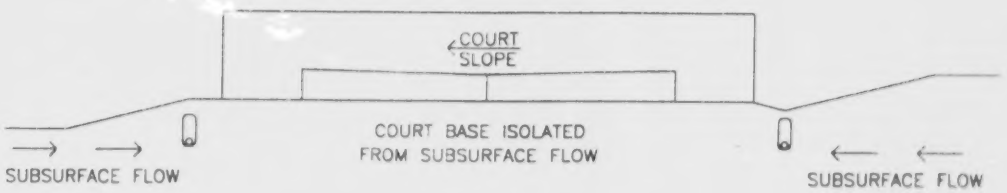
Subsurface drainage addresses the management of water below ground which is present in soil or rock.

One way of controlling both surface and subsurface water is by construction of a French drain. A French drain places an underground barrier between the facility and approaching subsurface water. The most common type of French drain consists of a trench around the perimeter of the facility and at least 5' (1.524m) from the pavement to prevent water from percolating out of the drain and under the court. The trench should be 12" (305mm) - 24" (610mm) wide and usually 24" (610mm) - 48" (1.219m) deep. The drain should be at least 18" (457mm) deep, but not less than the depth of the subbase of the court or courts, depending on local conditions. Permeable aggregate is placed in the bottom of the drainage trench to create a slope to move the water away from the court; a slope of at least 1% (1:100) is required. Next, a porous or perforated pipe is installed on top of the aggregate. A porous cover is placed over the pipe to prevent silt or other materials from entering the pipe and clogging it. Finally, the trench is backfilled with additional permeable aggregate and finished with smaller washed stone for an open drain or, when a closed drain is required, with sod or a drainage swale. Usually, French drains are covered over with lawn and do not handle large volumes of surface drainage.

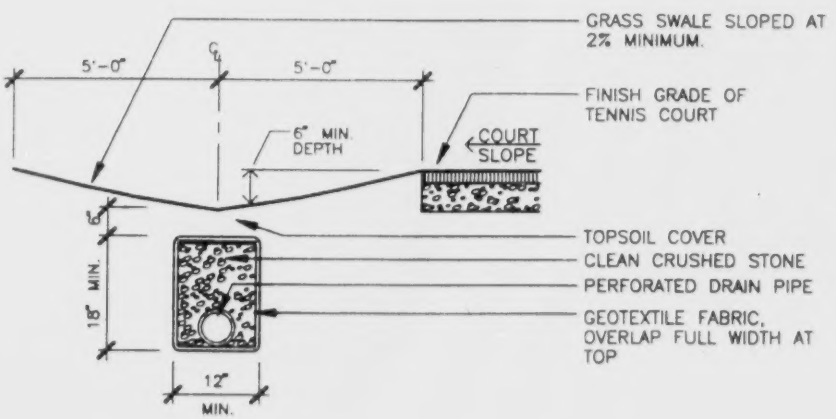
A relatively new variation of the French drain uses geocomposite drainage tile. This material has made possible the construction of subsurface drainage with a much smaller trench. The tile is inserted in the trench where its unique egg-carton surface allows it to hold a great deal of water. The tile is then covered by a non-woven filter fabric to prevent soil and other small particles from clogging the drain, and the trench is backfilled. This type of subsurface drainage is not only easier to install, but easier to repair should it become clogged.

Another variation of the French drain, called a footing drain, is used where a hillside or high area slopes down directly to the court site. In this instance, a retaining wall may be constructed at the base of the hillside with a footing drain at the base of the wall on the high side.

In the case of both surface and subsurface drainage, proper slope and consistency of grade is important. It is also important that an appropriate means of disposing of the collected water be identified. When considering a site, look for a low area which would constitute a natural drain field. Other options include landscaped areas, holding ponds, creeks or hillsides.



TYPICAL SUBSURFACE DRAIN LOCATION



SECTION GRAVEL TRENCH DRAIN
AT EDGE OF TENNIS COURT

SUBSURFACE DRAINAGE AT COURT EDGES

NOT TO SCALE

DRAIN – 4

U.S. TENNIS COURT AND TRACK BUILDERS ASSOCIATION

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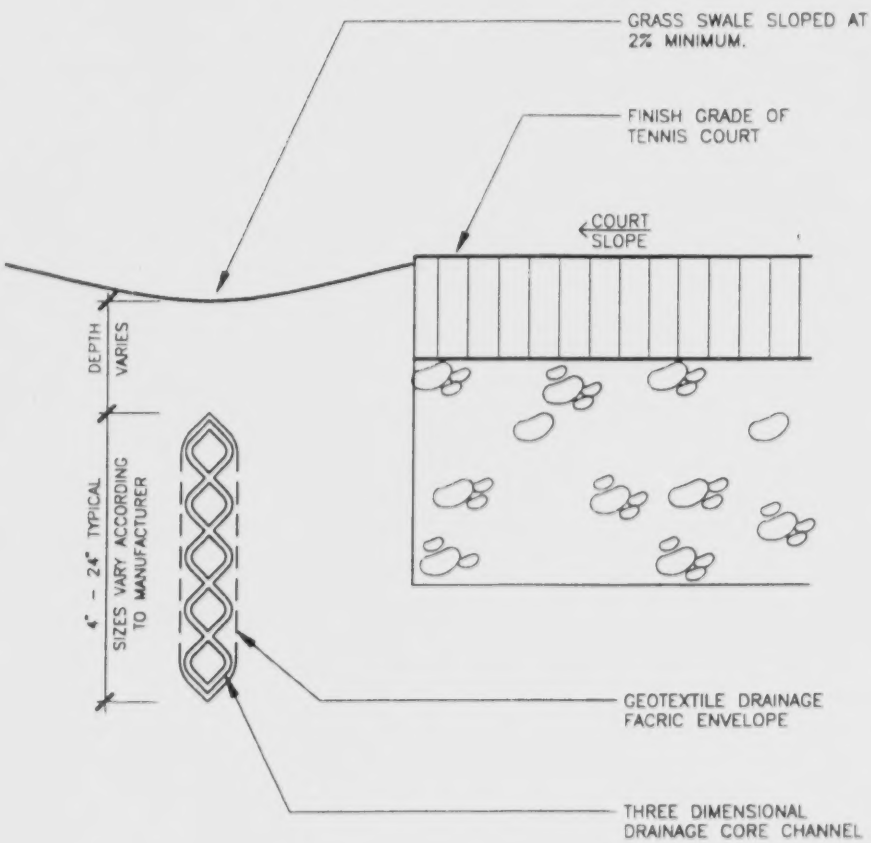
GRASS SWALE SLOPED AT 2% MINIMUM.
FINISH GRADE OF TENNIS COURT
COURT SLOPE
DEPTH VARIES
4" - 24" TYPICAL SIZES VARY ACCORDING TO MANUFACTURER
GEOTEXTILE DRAINAGE FACRIC ENVELOPE
THREE DIMENSIONAL DRAINAGE CORE CHANNEL

ROCKLESS OR GEOCOMPOSITE DRAIN AT COURT EDGE

NOT TO SCALE

DRAIN – 5

U.S. TENNIS COURT AND TRACK BUILDERS ASSOCIATION

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Catch Basins

Where topography or the presence of buildings, rocks, trees or other fixed obstructions precludes moving water to a natural low area, creek or other drain field, a catch basin may be used. A catch basin acts like a shower drain. It is a concrete or masonry box structure built below grade with a plastic or metal grate on top. Water is directed by swales, gutters or subsurface piping to the catch basin, which directs it into pipes to carry it away from the site to a place where it can be dispersed. If water cannot be drained from the catch basin by gravity because of the grade of the site or because of obstructions, a sump pump can be used to eject water from the catch basin.

It is important to note that drainage is placed around tennis courts. Ideally, drainage should never be placed under a tennis court.

Site Grading

Grading the playing surface is critical for good play. Of course, the ideal site is level (Note: All outdoor tennis surfaces must be sloped to drain, but beginning with a level site makes grading and designing an optimum drainage system easier). Since a tennis court requires a large site (an overall site of 80' (24.384m) X 140' (42.673m) is recommended for a single court project), level sites of this size are rare. Most sites will require some cutting and filling. In addition, topsoil, rocks, tree stumps or large roots must be removed and any resulting holes filled. In some locations, blasting may be required to remove rock to a level where a suitable subbase can be constructed. In other locations where portions of the site are low, they must be raised by the addition of fill materials.

Blasting, extensive excavation and/or fill add to the time for construction and to the cost of a project. Where large rocks or stumps are excavated and holes created, or where fill material is added to level the site, both surrounding soil and fill material must be compacted before construction can be continued. Fill material must be stable and compactible. It should be free of any organic matter which will decompose over time and lead to settling. The burring of tree roots or stumps below a court pavement, for example, can lead to costly pavement failures due to settlement.

Proper excavation of a site is essential to a well-constructed tennis court. Here, a contractor excavates an area to be used for a residential court. PHOTO COURTESY OF SPORTSLINE, INC.

Because the fill material is different from the surrounding material, it may compact differently. Where large amounts of fill are required or where the depth of fill is variable over the area of construction, great care must be taken to achieve consistent compaction since an unstable subbase or uneven settlement can cause cracking or surface failure. Filling should be completed in 6" (152mm) lifts and thoroughly compacted before the next layer is added. This process should be repeated until the desired grade is achieved.

Proper grading of the construction site and proper slope of the playing surface provides a means of removing water from the court surface without affecting play. Excavation, filling, grading and compaction of the site and construction of the subbase should be performed in such a way that the subbase is 4" (102mm) - 6" (152mm) above the surrounding ground and the finished court surface is 10" (254mm) - 12" (305mm) above the surrounding ground. Each court should then be sloped in a true plane. A hard surface court should slope 0.83% (1:120) to 1% (1:100). More slope than this would affect play. Sand-filled turf courts are typically built on asphalt or concrete. Therefore, they, too, should slope between 0.83% (1:120) and 1% (1:100). Grass courts should be sloped at 1% (1:100). A soft surface court should slope more gradually since a steeper slope would erode the surface material. Not less than 0.28% (1:360) and not more than 0.35% (1:288) is recommended with above surface irrigation and not less than 0.14% (1:72) and not more than 0.28% (1:360) for courts with subsurface irrigation.

In order of preference, the court should slope side to side, end to end or corner to corner. The natural slope of the terrain on which the court is built should be considered and the shortest direction for good drainage and water removal should be chosen.

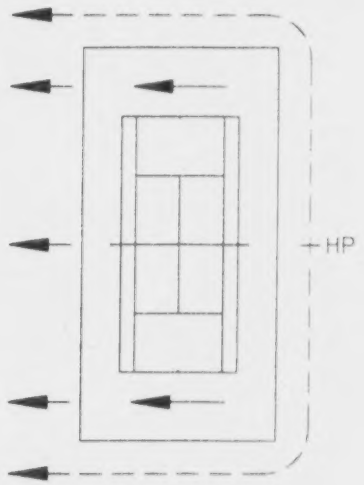
In choosing the direction of the slope, the number of courts to be built in a battery should be considered as well. If a battery of three or more courts is sloped side to side, the change in elevation from the high side of the first court to the low side of the last court is considerable, with all the water from all the courts running across the entire battery. As a rule, no more than three courts (180' (54.864m) if sloped side to side) should drain in the same direction or one court (a maximum of 130' (39.624m)), if sloped end to end, without the storm water being intercepted. If the total surface area of the courts or the length of drainage is greater, storm water runoff could cause erosion, surface abrasion or undermining of the areas around the edges of the court where the storm water is deposited, leading to pavement failure. In such a situation, terracing the courts is one option. Another option is to use trench drains to intercept the water on the courts. The trench drains must be kept out of the area of play. Catch basins should never be used on tennis courts as they require a depressed area and could constitute a tripping hazard for players. For purely aesthetic reasons, sloping a battery of more than two courts by breaking the plane of the courts, sloping some in one direction and some in another, is considered undesirable. The rise and fall of the baselines and the top rail of the fencing that results from this method can be distracting visually. However, topography, drainage needs or budget constraints may mandate this choice.

Tennis courts should never slope from the net line toward the baseline or from the baseline toward the net, since this has the effect of raising or lowering the net. Neither should they be sloped from the center line to the sides since this creates a hump in the court which affects play. The entire court must be sloped in one plane.

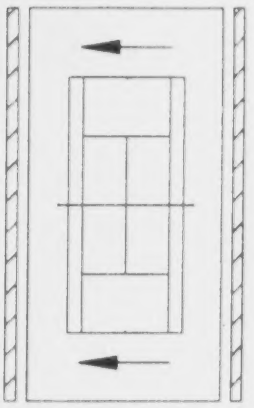
The finished court surface should be 10" (254mm) - 12" (305mm) above the surrounding grade. While planning for excavation (cutting) and filling, consideration should be given to blending the plane of the tennis court back into the surrounding surface. If this is to be accomplished entirely with shaping of the ground, the maximum slope for the lawn surface is 33% (1:3). More slope in a lawn surface will result in erosion and maintenance problems. If the slope is stabilized with gravel, erosion fabrics or plantings, the slope can be increased to as much as 100% (1:1).

In planning for blending the tennis court back into the surrounding terrain, consideration also must be given to drainage. Surface storm water should never be allowed to drain down a cut or filled slope since it may lead to severe erosion and instability. Ultimately, this may damage the court. A diversion swale or gutter should be installed to prevent water from running down the uphill side of the court. Surface water run off from the court must be collected on the downhill side of the court, as well, to prevent erosion.

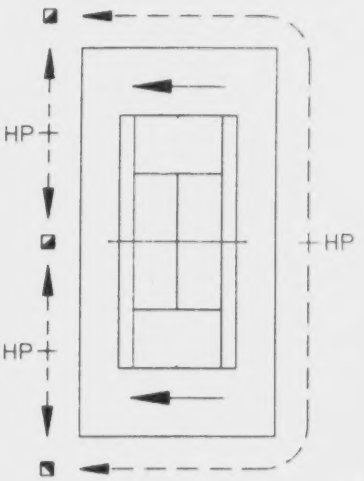
Some sites will require retaining walls to stabilize cut and fill. Retaining walls may be constructed of masonry, reinforced concrete, wood ties and/or precast concrete.



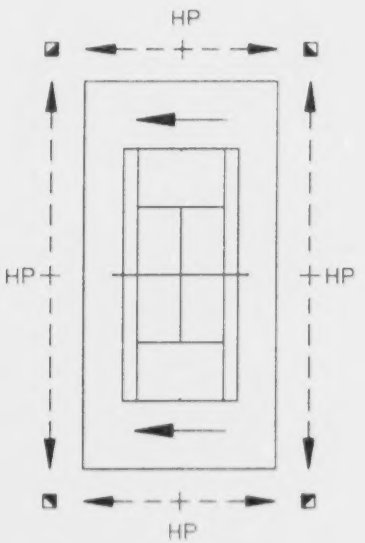
LAWN SWALES



TRENCH OR
INTERCEPTOR DRAINS



LAWN SWALES AND
CATCH BASINS



LAWN SWALES AND
CATCH BASINS

TYPICAL DRAINAGE PATTERNS FOR ONE TENNIS COURT

NOT TO SCALE

DRAIN – 1

U.S. TENNIS COURT AND TRACK BUILDERS ASSOCIATION

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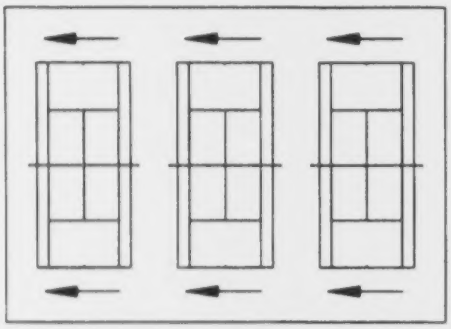
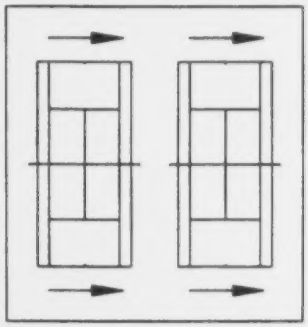
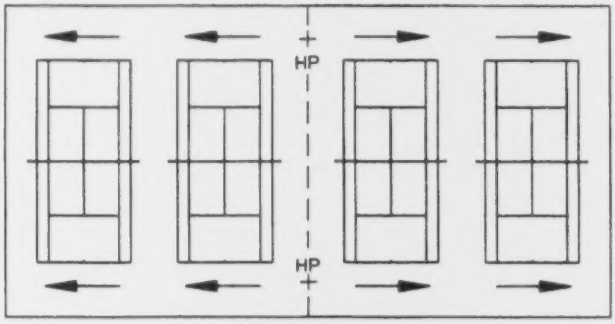


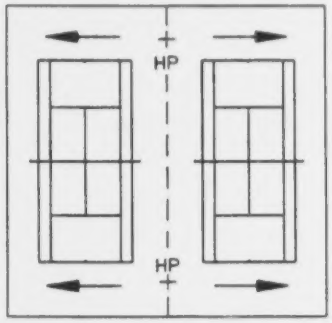
DRAINAGE IN A SINGLE PLANE
(SIDE TO SIDE PREFERRED)



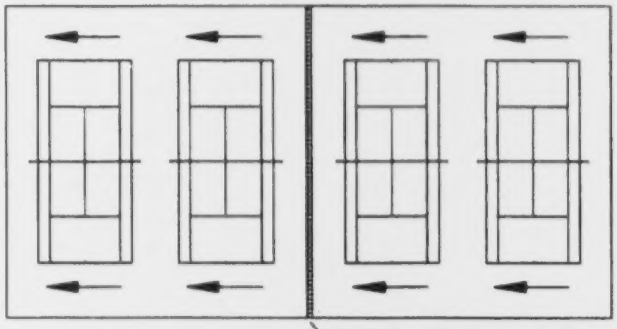
DRAINAGE IN A SINGLE PLANE
(SIDE TO SIDE PREFERRED)



DRAINAGE WITH CENTERED HIGHPOINT
(ONLY WITH DIVIDER FENCE)



CENTERED HIGHPOINT
(ONLY WITH DIVIDER FENCE)



6" MIN. WIDTH TRENCH DRAIN
12' RECOMMENDED MIN. BETWEEN
DRAIN AND SIDE LINE OF COURTS.

DRAINAGE IN A SINGLE PLANE
WITH INTERCEPTED FLOW

NOTES:

MAXIMUM RECOMMENDED LENGTH OF SLOPE ACROSS COURT SURFACES IS 180'. LONGER LENGTHS CAN LEAD TO EROSION OF THE SURFACE OR SURROUNDING AREAS.

TYPICAL DRAINAGE PATTERNS FOR MULTIPLE TENNIS COURTS

NOT TO SCALE

DRAIN – 2

U.S. TENNIS COURT AND TRACK BUILDERS ASSOCIATION

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Drainage should be included with all walls. This includes footing drains as well as weep holes (openings in the wall to permit passage of water collected behind the wall). Footing drains need to be connected to storm systems. Weep holes need to be placed so that they do not drain directly onto the court surface causing staining and degradation of the surface. If a retaining wall abuts the tennis court surface, a trench drain should be constructed between the wall and the court.

If walls face directly onto the court, they should not have protrusions or abrasive surfaces which could injure players. Retaining walls on the downhill side of courts should be properly fenced to avoid player injury as well. As with all fixed obstructions, retaining walls should be a minimum of 12' (3.576m) from the sidelines and 21' (6.401m) from the baseline of the court to prevent player injury.

While careful grading, compaction and use of retaining walls, where appropriate, can make almost any site useable, the more site preparation is required, the greater the cost of the facility will be and the more potential there will be for problems, both during and after construction.

Trees and Other Vegetation

While trees and other natural growth can enhance the aesthetics of a site, provide shade for players and spectators, create a background against which to see the ball and screen out distractions, the type and location of such growth must be considered. Tall trees on the side of the court, for example, can create a distracting shadow pattern on the court when the sun is behind them.

Both deciduous trees, which drop leaves, and evergreen trees, which drop pine cones and needles, can cause maintenance problems if the debris they create is not removed. Such material must be removed, not only because it impedes play, but because if left in place, it will cause staining. Shade from trees can provide a cool, damp medium for algae or fungus growth on the court surface, as well.

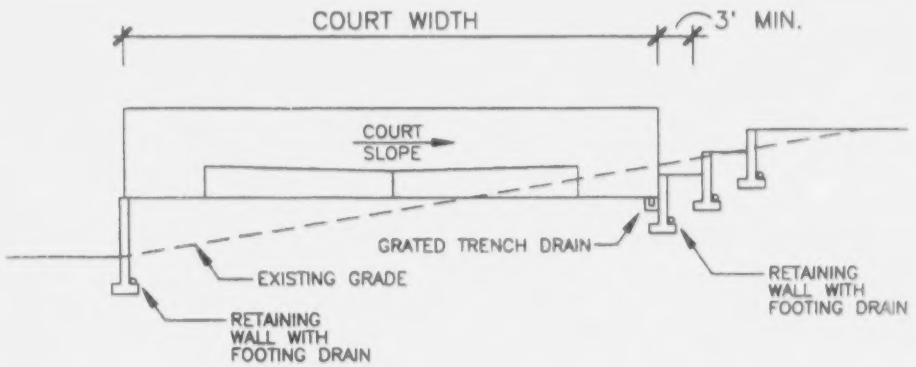
Tree roots which extend under the court area must be neutralized or removed prior to construction. For this reason, removing all vegetation back 10' (3.048m) from the edge of the playing area, leaving a cleared site of 80' (24.384m) X 140' (42.672m), is commonly recommended. Where this cannot be accomplished, removing vegetation back 5' (1.524m) is considered minimum. Removing vegetation from around the construction area can be costly, but costs are often recovered in lower short term and long term maintenance. Removing vegetation also can alter the look and feel of the site. Where removing vegetation is not practical, root barriers are sometimes used.

Site Planning

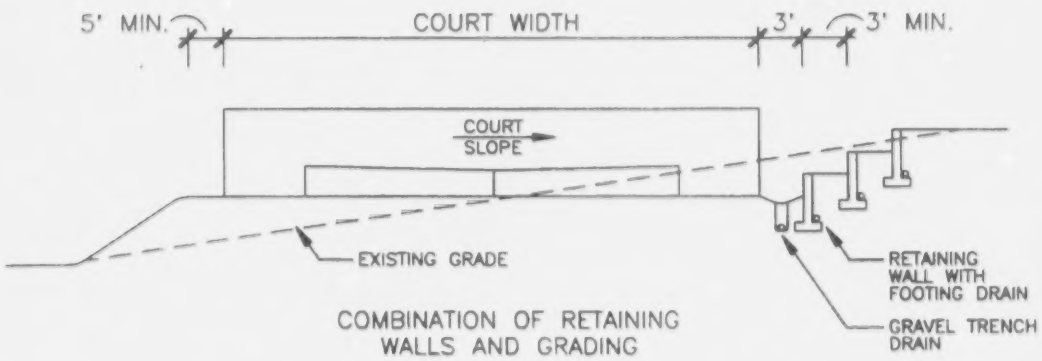
Orientation and Layout

One of the primary considerations in laying out a tennis court is solar orientation. A tennis court should be laid out to minimize the need for players to look into the sun when serving or when following the flight of a ball. A tennis court also should be laid out to minimize distracting shadow lines and patterns on the court surface.

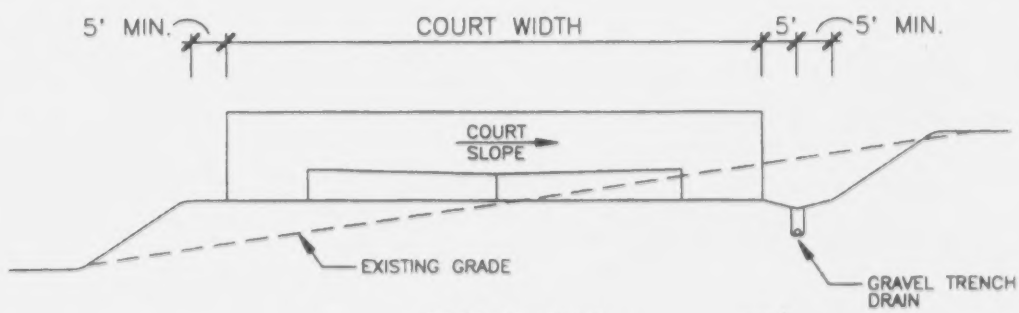
Theoretically, the best possible layout would be to orient the longitudinal axis of the court perpendicular to the azimuth of the sun. (The azimuth is the angular measurement of the horizontal location of the sun along the horizon in relation to true north.) Data relating to the azimuth of the sun on an hourly and seasonal basis can be



RETAINING WALLS ONLY



COMBINATION OF RETAINING WALLS AND GRADING



GRADING ONLY

NOTE:
COURT SURFACES SHOULD DRAIN UP-HILL (INTO THE SLOPE) RATHER THAN DOWN-HILL TO PREVENT EROSION WHICH COULD DESTABLIZE THE COURT.

COURT CONSTRUCTION ON A SLOPED SITE

NOT TO SCALE

RETAIN - 1

U.S. TENNIS COURT AND TRACK BUILDERS ASSOCIATION

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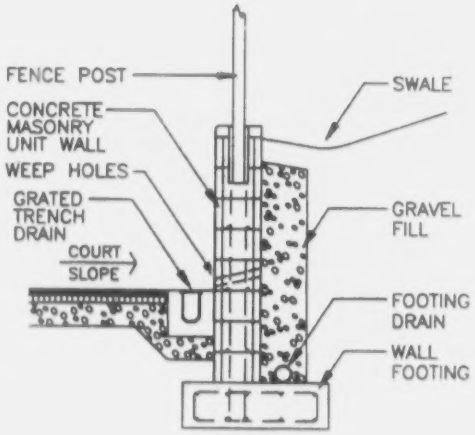
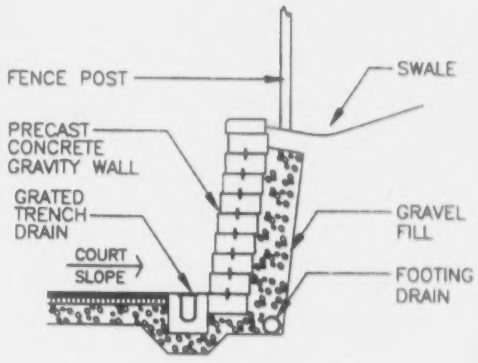
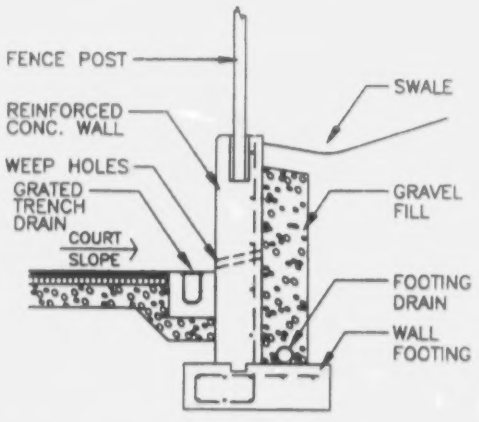


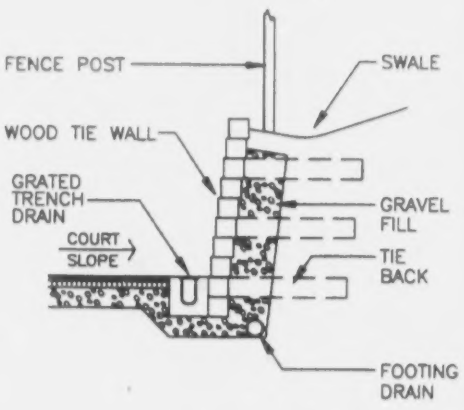
CONCRETE MASONRY UNIT WALL



PRECAST CONCRETE GRAVITY WALL



REINFORCED CONCRETE WALL



PRESSURE TREATED WOOD TIE WALL

TYPICAL RETAINING WALLS AT UP-HILL SIDE OF COURT EDGE

NOT TO SCALE

RETAIN – 2

U.S. TENNIS COURT AND TRACK BUILDERS ASSOCIATION

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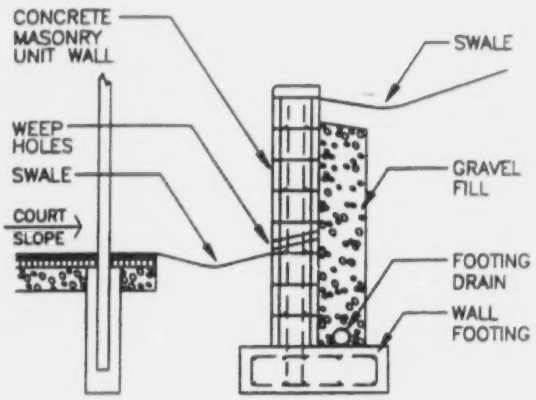
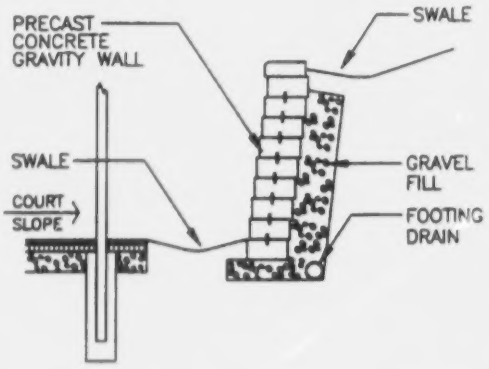
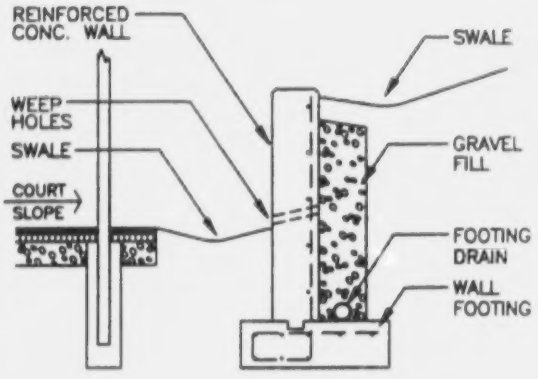


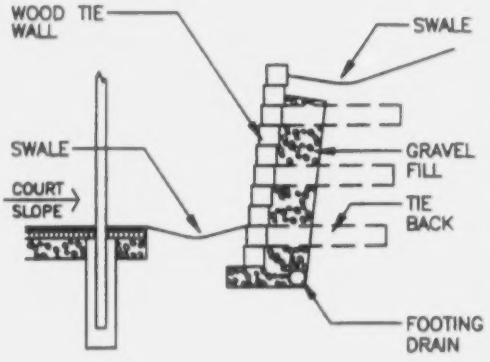
CONCRETE MASONRY UNIT WALL



PRECAST UNIT GRAVITY WALL



REINFORCED CONCRETE WALL



PRESSURE TREATED WOOD TIE WALL

TYPICAL RETAINING WALLS AT UP–HILL SIDE OF COURT (SET BACK)

NOT TO SCALE

RETAIN – 3

US TENNIS COURT AND TRACK BUILDERS ASSOCIATION

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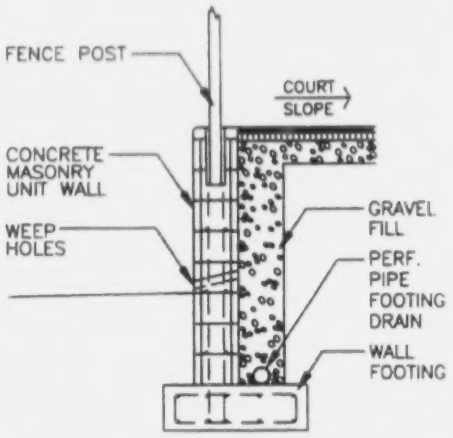
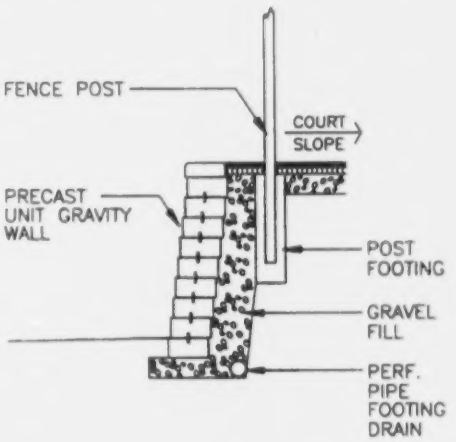
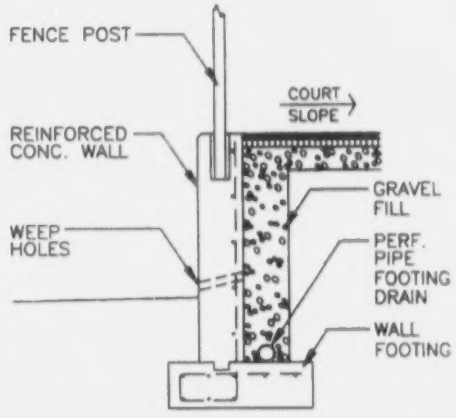


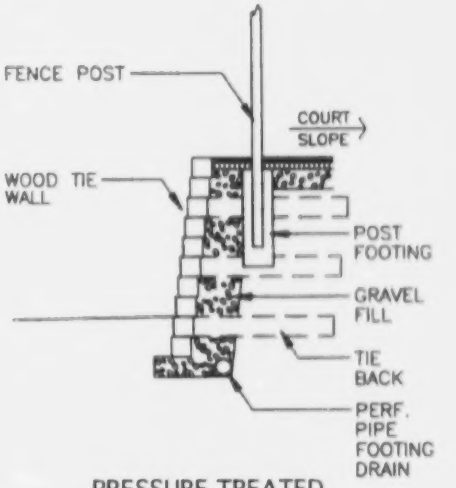
CONCRETE MASONRY UNIT WALL



PRECAST UNIT GRAVITY WALL



REINFORCED CONCRETE WALL



PRESSURE TREATED WOOD TIE WALL

TYPICAL RETAINING WALLS AT DOWN-HILL SIDE OF COURT EDGE

NOT TO SCALE

RETAIN – 4

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obtained from meteorological, navigation, surveying or solar architecture reference books. Since the azimuth of the sun constantly shifts according to the time of day, the season and the latitude in which it is observed, it is difficult to generalize about an ideal court orientation.

It is important to remember that the orientation of the court should be in relation to true north, not to magnetic north. The angular difference between true north and magnetic north is referred to as the "deviation of magnetic north." This deviation changes according to geographic location. Information relating to the deviation of magnetic north from true north can be easily obtained from a local surveyor or airport facility.

In more practical terms, the orientation of a tennis court should be chosen after careful consideration of three factors: (1) the latitude in which the court is constructed, (2) the season during which the court will be used, and (3) the time of day during which the court will be used. The final orientation will be a compromise between these factors since the sun's location is constantly moving throughout the day and throughout the year.

Play on a court during the early morning and late afternoon hours will be the most critical to consider, since during those times the sun is lowest to the horizon and most distracting to players and spectators. If the court is to be used consistently throughout the day, a true north-south orientation is recommended as the best compromise between the extremes of early morning and late afternoon solar angles. At mid-day the sun is at its highest location in the sky and, therefore, least distracting to players on a north-south oriented court.

It is not unusual to orient a tennis court to match a specific season. Courts in the northern United States, for example, are generally used from late April to October. Therefore, northern courts usually are oriented according to the summer solstice which is approximately mid-season and, therefore, an average of the varying solar angles during this period. In the southern United States, the milder climate allows for play year round. For this reason, southern courts often are oriented according to either the spring or fall equinox, again an average of the varying solar angles.

Orientation can be even more specific. If a court is to be used most often in the afternoon hours during the spring, as is the case with many collegiate facilities, the court should be oriented west of north for the months of April and May to minimize conflict with the afternoon sun. If the court is to be used for a specific tournament to be held at the same time of the year every year, the court can be oriented properly for the actual hours of play for the final match.

In most cases, however, determining a tennis court's orientation is a matter of balancing the extreme differences in the sun angles during the playing season and compromising between solar orientation and other factors. For example, orientation also should take into consideration other structures and features on the site, neighboring property, vehicle and pedestrian traffic, and prevailing winds. Property lines and efficient site utilization should be considered as well.

When orienting courts, consider the fact that a dark, solid background is desirable since it enables players to see the ball. Light backgrounds including light colored buildings, and moving backgrounds, such as vehicular or pedestrian traffic, should be avoided.

Courts should be away from traffic noise and from other sources of noise. The quality of play is affected when players are unable to hear the sound of the ball coming off their own racquet and that of their opponent. Further, sociability is diminished if conversation is difficult. Where necessary, windscreens, walls, hedges, trees and other landscaping can screen out visual distractions and noise.

In determining the layout of courts and other facilities, intended use of the project is a critical factor. A large centralized complex favors teaching and tournament play since it allows players and instructors to move easily from

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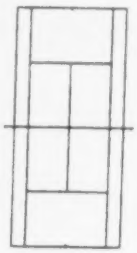
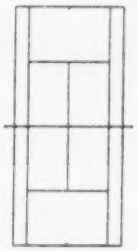
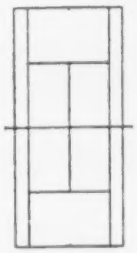
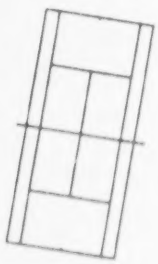
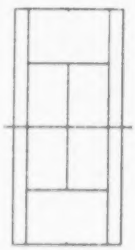
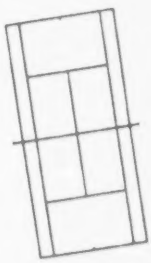
BOSTON, MA CHICAGO, IL GRANT'S PASS, OR (42.5° LATITUDE)			
	1° ROTATATION EAST OF TRUE NORTH	TRUE NORTH/SOUTH	1° ROTATATION WEST OF TRUE NORTH
NORTHERN UNITED STATES LOCATIONS			
RICHMOND, VA SPRINGFIELD, MO SAN FRANCISCO, CA (37.5° LATITUDE)			
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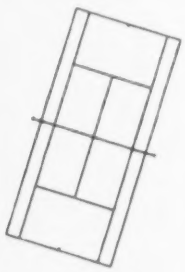
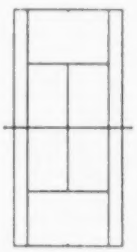
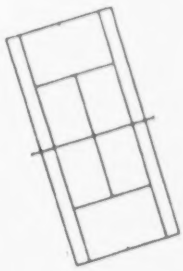
CENTRAL UNITED STATES LOCATIONS			
CHARLESTON, SC DALLAS, TX SAN DIEGO, CA (32.75° LATITUDE)			
	17.25° ROTATATION EAST OF TRUE NORTH	TRUE NORTH/SOUTH	17.25° ROTATATION WEST OF TRUE NORTH
SOUTHERN UNITED STATES LOCATIONS			

TENNIS COURT ORIENTATION

NOT TO SCALE

ORIENT

U.S. TENNIS COURT AND TRACK BUILDERS ASSOCIATION

USTA

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one court to another and allows spectators to watch more than one match at a time. On the other hand, for recreational or social play, banks of two courts spread out over a facility with landscaping create a feeling of privacy and relaxation.

Access

Often overlooked in site planning is adequate and attractive access. Access includes roads, parking, paths and gates to the tennis courts.

Unlike many sports, a good tennis match can be played in an hour. Players often fit in a match before or after work or on a busy weekend between other obligations. The ability to get to the courts easily and to park nearby is important. In terms of maximizing player traffic, a site in a densely populated area with good access is ideal. Such sites often are prohibitively expensive. Site costs, however, must be weighed against the effect of access on player traffic. If a court is too far away or too hard to get to, it will likely be underutilized.

Easy player access is the key to well-utilized tennis courts. Here, a wide path leads up to two courts, each of which has a private entrance. The landscaping around the outside of the gate makes the area even more inviting. PHOTO COURTESY OF GLOBAL CONSULT GROUP, INC.

Adequate parking near the courts is desirable; however, parking should not be adjacent to the courts, where the coming and going of players creates a distraction.

Attractive paths to the courts establish a tone. Bear in mind, however, that modern tennis players often tote two or more racquets along with a sports bag. Make certain that paths are wide enough that two players carrying their equipment can walk side by side. Paths must be disabled accessible as well. Six foot (1.829m) wide paths are recommended; 4' (1.219m) wide paths are considered minimum.

It is annoying to tennis players to have other players walk behind them to get to another court or to retrieve a ball. Providing individual gates for each court in a battery or at least one gate between each two courts enhances play. At least one gate per court or per battery should be wide enough to allow access for routine maintenance as well; this gate may serve as a disabled access gate.

Ease of access for construction vehicles, including heavy equipment required for grading and delivery of materials, will help to keep costs down. Whenever possible, however, the conservation of natural areas and trees will enhance the ambiance of the completed facility.

The Americans with Disabilities Act requires that all facilities, including tennis facilities, be accessible to both players and spectators in wheelchairs. This means that at least one court must be fully accessible; more may be required if the facility is especially large. Paths to and from courts and gates into courts must accommodate wheelchairs. Curb cuts may be necessary. Drinking fountains, locker rooms, rest rooms and other player/spectator amenities must comply with federal, state and local codes on accessibility. Adequate handicapped parking must be provided.

Utilities

Tennis facilities require electricity for lighting, ball machines and other amenities. They require water for maintenance, drinking fountains and, in the case of soft courts, irrigation. Telephone lines permit installation of a phone for player convenience, safety and security. Sewage lines or a septic system will be required if restrooms are to be constructed. The availability of utilities and the distance that utilities must be brought in will affect the cost of the project.

Permitting

A properly zoned site must be available for any tennis facility project. Any possible variance or special exception which must be obtained from local, municipal or state governments or from property owners associations should be considered. Site preparation and building permits, if required, should be obtained. Local codes should be considered including type of zoning, fence location and height, erosion control and drainage considerations, flood plains, access roads, parking requirements, utilities and setbacks. Conservation, wetlands and historic preservation regulations may be factors at some sites. An environmental impact statement may be required. The municipal or county clerk's office or a local contractor can usually provide information regarding which permits and regulations affect the site. Permitting is a time-consuming process; adequate time for permitting, with possible delays, should be allowed when scheduling a project.

Impact of Region, Geography and Location

The Northeast and Midwestern areas of the country are subject to multiple freeze-thaw cycles during winter. The more frequent the freeze-thaw cycles and the greater the depth the ground freezes in a given region, the more carefully soil conditions, drainage and subbase construction must be considered. Soft courts, such as clay, fast dry and grass, and post-tensioned concrete courts may be less affected by freeze-thaw activity than hard courts such as asphalt and reinforced concrete. Soft courts also are more easily repaired following settlement or heaving.

Colder climates also have limited playing seasons. While soft courts must usually be closed for the winter in colder climates, hard courts such as asphalt or concrete, often can extend the playing season. Even in the middle of winter, they are ready for play on any warm day, and, on hard courts, play resumes earlier in the spring and continues later in the fall than on soft courts.

In Southern and Southwestern states and at high altitudes, sun will be the enemy of the court, bleaching out the color of hard courts and drying clay or fast dry courts. Subsurface irrigation systems for soft courts not only eliminate the need for frequent sprinkling, they conserve water. Fast dry courts also are cool to play on. The constant evaporation of water from the surface acts as natural air conditioning, cooling the air above the court.

While desirable for all courts, wherever the sun is strong, shade shelters and drinking fountains are essential. In the hottest climates, even with such protection, it may be too warm for midday play. Installation of lighting will

extend playing hours by allowing play in the early morning and late evening.

In considering the type of court to build, the availability of materials locally and the experience of local contractors will affect the cost of the project.

Types of Projects

Parks, Recreation, Schools, Institutional and Public Community Courts

Good design and quality construction is essential for all courts. Often, however, public projects are affected by budget constraints, complex and detailed bidding processes, multiple priorities and similar limitations. In some cases, public and institutional owners settle for inadequate, poorly designed or poorly constructed facilities which are then underutilized because they are unsatisfactory to tennis players. Such facilities suffer continuing problems such as cracking and delamination, as well. In other words, poorly designed and poorly built courts are not cost effective.

Another problem common to public projects is the multi-use recreational facility where basketball courts, softball fields or playgrounds are built next to or nearby the tennis facility. The noise and distraction caused by these facilities make tennis play difficult.

Still another concern is that community tennis growth often leads to a pattern of decentralized facilities. The community finds a small plot of land and builds one or two courts here, then one or two somewhere else. Eventually, there are many courts, scattered throughout the area, but no central tennis center and no area large enough to build one. Such a center allows economical programming and maintenance, the establishment of a pro shop, the conduct of special events, the development of instructional programs, children's and senior activities and tournaments. Community officials, therefore, must plan for the long term in developing tennis facilities, planning not only courts for play, but a community tennis center to meet the needs of a community tennis program.

Such problems common with public facilities can be overcome with creative planning. For example, cooperative ventures between park and recreation departments and nearby school boards may free up sufficient funds to produce better quality facilities which are fully utilized, resulting in more effective use of public funds. Such cooperative ventures, likewise, overcome some of the challenges inherent in financing public tennis facilities. Traditional sources of funding for public facilities have included tax revenues, bond issues and federal matching funds. Cooperative ventures between various public agencies as well as public/private partnerships vastly expand available sources. For example, a university may build a tennis center for use by its tennis team and students, but may allow the community or even a private partner to utilize the facility as a club during otherwise unused hours, generating revenues for the university which cover the cost of construction and operation of the tennis center. Community tennis associations may partner with local governments to seek grants or raise funds to build facilities through the conduct of special events such as tournaments or tennis camps, earning long term, no cost or low cost use of the facility.

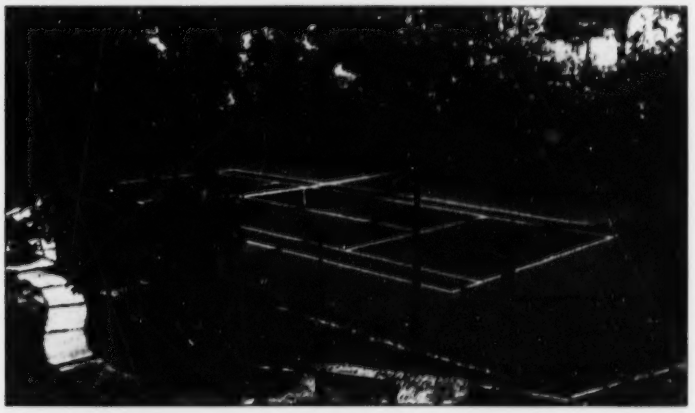
While there has been and continues to be strong support for free public recreational facilities, another option which has grown in recent years is the establishment of usage fees to build, maintain and expand specialized public facilities such as tennis centers. Communities with both a tennis center and neighborhood courts often offer free court time at the small neighborhood complexes while charging user fees for the better equipped and staffed tennis center. It is interesting to note that most of the public tennis facilities which have earned recognition in the USTA awards program charge a nominal fee for play. Fees charged to the user help offset the increasing demand on local tax dollars by placing the cost of operations on the individuals who enjoy these facilities. Such fees can serve as a supplementary or primary source of revenue to build, operate and maintain a facility.

In building public tennis facilities, as in planning any tennis facility, the needs of players must be considered. At a minimum, a playing surface of 60' (18.288m) X 120' (36.576m), a shade shelter and bench for players, individual court access, 24' (7.315m) between courts in a battery with divider fence (or if less space is available, divider netting between courts), and a source of drinking water are necessary if courts are to be attractive and comfortable for players. Courts should also be free of visual distractions and noise.

Residential and Private Community Courts

Individual residential courts and courts in residential communities may not require elaborate player amenity areas since players are near their own homes; however, comfortable player and spectator seating and shade shelters enhance the tennis experience.

Tennis is a social sport. Seating areas for watching matches or for relaxing after play, convenient restrooms and, perhaps, a built-in barbecue will make the tennis court a social center for the family or for the community.



A residential court situated in a pretty, shaded area. Note the details that add to the environment for both players and spectators — a curving walkway, casual deck chairs and park-style benches, a shade shelter and lights for night play. The black fence blends into the surroundings. PHOTO COURTESY OF HOWARD B. JONES & SON, INC.

For community tennis courts, functional areas for players to meet and wait, sun shelters and drinking fountains should be provided. Playgrounds for players' children may be a desirable addition to the facility.

When constructing tennis courts at private residences or in residential communities, consideration must be given to neighboring homes. Lighting should be designed in such a way as to minimize spill outside the playing area and landscaping to dampen noise also should be considered.

Residential community tennis courts may require some security planning to minimize the potential for misuse and abuse. Consideration should be given to limiting access to unauthorized persons, lighting after hours or landscaping in such a way that courts remain visible from nearby homes or roadways. The availability of a telephone at the courts is both a player convenience and a safety/security feature.

Of course, in planning residential and community courts, restrictions promulgated by the homeowners association must be considered.

Club and Resort Facilities

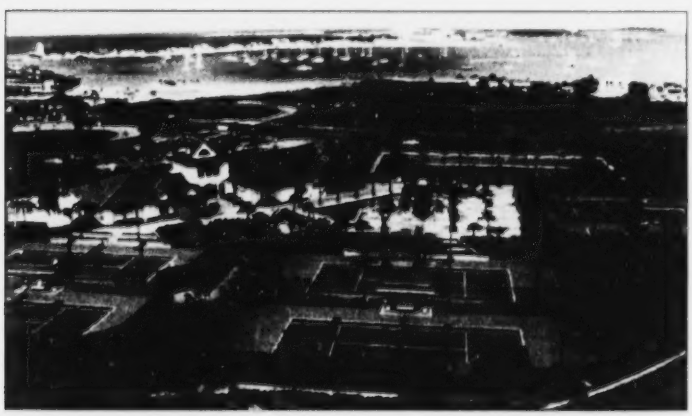
Many club and resort facilities don't give tennis a chance to succeed. Often, the club or resort tennis center consists of a few courts added almost as an afterthought. The club entrance, clubhouse, pro shop and refreshment centers are most likely near the golf course and, possibly, distant from the tennis courts. In fact, everything about the

tennis facility probably invites players to come and go quickly. Often tennis courts at clubs and resorts lack even basic player comforts such as shade shelters, spectator seating, restrooms and drinking water.

A number of factors weigh in favor of tennis operations as an area of potential growth for clubs and as an enhancement to the guest amenity package at resorts. In most clubs and resorts, golf and other facilities may be at or near maximum utilization while tennis facilities may be underutilized and tennis programs may be minimal or nonexistent. Increasing tennis memberships and revenues from tennis programming is an obvious way for clubs and resorts to increase income. Some examples:

Tennis facilities, if lighted, can be used in the evening. Some club members may not be able to take off work during the week to play golf, causing a high demand for tee times on weekends. Many players, however, may be able to stop for a game of tennis before or after work, or during their lunch break, creating midweek traffic and, perhaps, increasing use of clubhouse food and beverage outlets during the week. Resort guests may choose from many daytime activities including water sports, sightseeing, etc., but may round out their day with an early morning, late afternoon or early evening tennis match.

Another factor favoring tennis is the time it takes to play. With more and more people working longer hours, it is far easier to find time for an hour of singles play or an hour and a half of doubles play than for a round of golf. Also, at resorts, tennis players can fit in tennis every day and still have plenty of time for other activities.



These resort tennis courts are designed to increase player enjoyment. The large amount of space between courts, as well as the dark windscreens, protect players from distractions, while the shade shelters between courts allow seating for a few spectators, or for players taking a break from their game. This layout encourages player interaction, yet prevents balls from straying onto other courts. PHOTO COURTESY OF GLOBAL CONSULT GROUP, INC.

The aging population favors tennis, too. Evidence abounds that interest in tennis among older Americans is growing. In response to player demands, the USTA now offers tournaments and ranking in a men's 85+ division and a women's 80+ division. Not only is the number of senior tennis players growing, but those players are serious about the game, often playing several times each week.

Finally, even in a recessionary economy, adults who put off spending money on themselves will continue to spend money on their children. Children under the age of twelve, even tiny tots, are, in most cases, too young for golf play or for clubhouse use, but they can learn and play tennis. This creates a potential for summer tennis camps, weekday morning children's classes and other programs for children at both clubs and resorts. Children's programs often attract parents or other adults and generate pro shop sales as children outgrow their tennis clothing, shoes and racquets. In fact, studies have shown that the success of clubs is directly proportionate to the size and excitement of its youth programs. It is equally clear that two-career families are choosing resorts which appeal to both adults and children.

A tennis program can be successful and profitable, but the key to success and profit are a quality, player-friendly facility, a well-run program and the availability of tennis products and services.

Providing a first-class playing facility with amenities that make it a comfortable place to play or to socialize can make a tennis center a hub of activity. A club or resort contemplating a tennis facility should consider approach paths and vistas, landscaping and landscape lighting. The goal is to draw people to the courts. Patios or decking, shaded seating areas for players or spectators, cabanas between courts, a central refreshment center, drinking fountains and restrooms should be part of the plans.

Properly designed and protected, a tennis facility can have a number of alternate uses including serving as a site for outdoor dinners, dances or concerts. A facility can be designed with special consideration to covering the tennis surface and tenting the court area to accommodate such alternate uses. With its restroom, seating and service areas, a tennis facility can become an outdoor entertainment area.

As golf plays up its sense of history and tradition in the private club and resort market, so, too, can tennis. A grass court, for example, provides a reminder of the past and helps to set the club apart from public facilities. In addition, a grass court can double as a lawn for weddings or barbecues, or a site for croquet or lawn bowling. Fast dry or clay courts, too, are popular with players and are rarely found at public facilities. Jasmine or ivy on fencing, or hedges, can replace windscreens, providing a background for players to see the ball while adding to the park-like atmosphere.

A club might strengthen its appeal to serious players by offering a choice of surfaces. If tournament or league play is planned, however, at least four courts of a single surface may be required. Six or more courts of the same surface are recommended for larger tournaments.

Teaching Courts

Courts designed for instruction should be arranged so that it is easy for instructors to move from court to court and to control more than one court at a time. Storage areas for ball machines, ball carts and hoppers should be provided and a ball retrieval system may be a valuable addition. Instructional facilities are heavily used; therefore, efficient operation and ease of maintenance are critical. The choice of surfaces and the number of courts of each surface as well as the quality of the maintenance is important.

For teaching beginners, it is preferable to have a court separated from public viewing areas, walkways and other courts. New players often feel awkward and self-conscious. A private court also allows the pro to give the beginner his or her undivided attention. Advanced players, honing their skills through instruction, on the other hand, often enjoy watching the action on nearby courts or having others watch them. For teaching children, it is recommended that spectator seating be provided for parents.

A demonstration court with tiered seating and a ball retrieval system is useful in teaching facilities where visiting pros may give clinics for large numbers of players. Another useful addition might be an instruction tower. Instruction towers provide an opportunity for coaches and instructors to supervise play on a number of courts, making an instruction facility more efficient.

A practice wall or rebound net can facilitate an individual player's skill development and practice between lessons. Practice alleys are efficient since they take up less space than courts and leave the courts themselves free for matches.

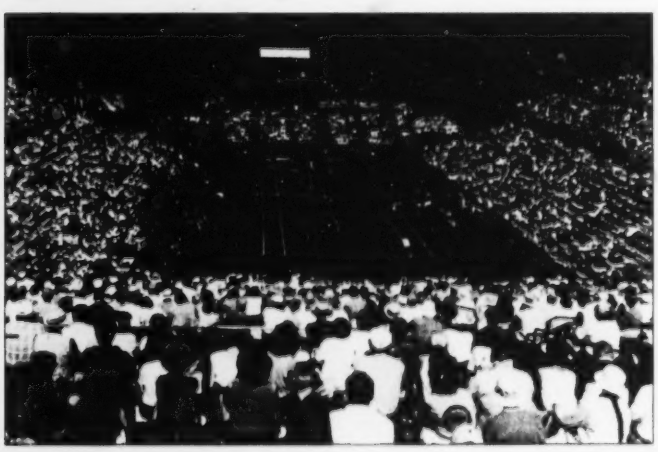
Facilities for Competition

For tournament and league play, at least four to six courts in a single surface usually are required. Banks of four or six courts expedite play by allowing players and officials to move easily from match to match and create excitement by allowing players and spectators to watch multiple matches.

The facilities required for competition depend on the type of competition planned. In tournament or ladder system competition, play begins on four to six courts simultaneously. As the tournament progresses, there are fewer matches. Eventually, the tournament is decided in a single match. Four to six courts in a single surface are required for preliminary matches. Because there is generally less interest in preliminary matches however, less spectator seating is required at these courts. There is great interest in the final matches, though. Often a stadium court, with seating for a large number of spectators, is required for these matches. An exhibition court may be a cost-effective alternative to a stadium court. The USTA offers prototype layouts for exhibition courts appropriate for sectional, regional, national and international competition. For an intra-club or inter-club tournament exhibition court, fencing in removable sleeves may temporarily be replaced by bleachers.

In collegiate competition, six matches are conducted simultaneously, with the team winner being decided by a point system. In this style of competition, six comparable courts are required. Spectator seating at each court is desirable.

Depending upon the type of competition, a number of additional items of equipment are required or desirable. These might include lighting, temporary or permanent umpire and linesmen chairs, an electronic line calling system, temporary or permanent scoreboards, court numbers and changing areas. A public address system is helpful, as well. In addition, if a large number of spectators will be accommodated for tournaments, parking, access, seating and restrooms for spectators, as well as a service kitchen, may be needed. One way to allow for flexibility is to install some or all of the court fencing in sleeves so that it can be removed to accommodate temporary stands for spectators during tournaments and replaced for regular play. Another attractive and flexible design is the amphitheater court where the court is surrounded by terraced lawns, providing a relaxed and casual environment for spectators.



This photo shows a stadium court designed specifically for tournament play, including room for television cameras, an umpire chair and line judges. The canopied areas behind the baseline provide room for VIP seating, press representatives and others. PHOTO COURTESY OF HOWARD B. JONES & SON, INC.

Consider providing spectator seating at the end of the court; viewing play from the end provides the best opportunity to analyze and follow the game.

For pro tournaments, provisions should be made for media coverage. Camera positions and announcers should be situated at one end of the court and above the stands, looking away from the afternoon sun. If courts are to be

lighted, the level of lighting required will be determined by the level of tournament play. Special lighting will be required for televised events.

For facilities which are being developed or adapted for tournament use, it is especially important to consult with the appropriate sanctioning organizations, such as USTA, ATP, WTA, etc. Additionally, if the event is to be televised, it would be wise to consult with the media group covering the event. Most tournament events have unique requirements. Typically, issues such as lighting, court sizes, utility requirements, player, official and spectator support facilities will need to be specifically addressed.

Tennis Centers

In designing tennis centers, whether public or private, certain considerations apply. For example, the control building should be centrally located among the courts and near the parking area. The manager's office should be located where he or she can see the maximum number of courts. Alternatively, video security may be required. The manager should have enough room for record files and for small conferences.

A lounge for players, parents and pros is desirable as is a pro shop which is both a convenience and a good source of revenue. Preferably, some or all of the courts should be visible from the lounge. A viewing deck also is recommended. It should be designed and located to provide maximum viewing of at least one court.

Locker rooms, toilets and showers are highly desirable and should be sized to meet the requirements of the facility. An enclosed tot lot is another attractive feature, but it should be placed so that noise from children playing does not disrupt tennis play.

Public phones and a source of drinking water should be placed near the courts, while snack and beverage vending machines or a snack bar should be located in the control building. That building should be attractive and well landscaped. Clocks, visible from the courts, a public address system and waste containers should be included in the plan.

A sufficient number of courts should be included to accommodate planned tournaments and some space should be provided for future growth. A staggered arrangement of courts or pairs of courts with landscaping in between are more attractive than a single bank. Cutting diagonal corners in the backstops improves the appearance of the facility, provides a location for individual court access and allows attractive landscaping. A shaded bench should be provided at each court for player seating and storage.

To allow for arriving and departing players, plan on at least five parking spaces per court with additional spaces for staff. Walkways from the parking lot to courts can be brick, tanbark, asphalt, stepping stones, concrete slabs or concrete. Loose gravel should be avoided as it sticks to the soles of tennis shoes and can damage the surface of the court.

Attractive landscaping not only improves the appearance of the tennis center but acts as a wind break and screens out distractions.

Collegiate Tennis Centers

Collegiate tennis centers must be designed to serve multiple needs. Among them: 1) varsity tennis training and competition; 2) academic sports programs; 3) intramural activities; 4) student, faculty and staff recreation; 5) summer camps, clinics, etc.; and 6) partnering efforts with the local community.

A collegiate facility designed to accommodate varsity tennis competition will require a minimum of six tennis courts, with larger collegiate tournaments utilizing up to 12 tennis courts. Courts are usually configured in groups of three and occasionally in groups of two. Spacing between courts should be a minimum of 18' (5.486m). Where space permits, it is recommended that courts be spaced 24' (7.31m) with 3' (914 mm) (minimum) divider fencing. Spectator seating should be planned to accommodate the number of persons that are expected to attend the tournaments to be held there. This will vary significantly among facilities; each tennis coach should be able to provide a recommendation.

It is recommended that lighting be provided for all collegiate tennis facilities since the student population must use the courts when they are not in class. Lighting makes the early morning and evening hours available for use.

Designing for Player Preferences and Special Populations

Athletic and Competitive Players

Athletic and competitive players often play singles so they use relatively more court time than doubles players. For a competitive player population, plan more courts per capita.

Speed of the surface and the relative effectiveness of spin is controlled by the size and quantity of sand or rubber particles mixed with color coating on hard courts. The rougher the texture, the more the surface will grip and slow the ball and the more effect will be evident from spin placed on the ball. Athletic players usually have a strong serve, prefer a serve and volley game and opt for a medium fast to fast surface.

Athletic and competitive players frequently come to the court dressed in tennis attire and leave almost immediately after their game, making social areas less important. On the other hand, they frequently carry several racquets and a sports bag. Wide pathways, a bench for a rest between sets and a storage area for equipment between courts are important.

Often, athletic players are intent on their game. They are annoyed by other players walking behind their courts. To minimize this distraction, provide individual court access. Likewise, they are annoyed by balls rolling onto their court in the middle of a great point. Allowing 24' (7.32m) between courts and installing divider curtains or fencing is recommended.

Because of the intensity of their game, they perspire and need water to prevent dehydration. Drinking water nearby and a shaded bench between courts are important player amenities.

Competitive players often enjoy watching other matches and being watched. Banks of up to four courts may facilitate spectating.

Recreational/Social Players

Recreational and social players sometimes prefer doubles tennis and may play longer than singles players. Often, they are baseline players. They look for longer rallies and a shot placement/spin type of game. A medium to slow surface is recommended.

Recreational and social players require convenient areas for players to meet before matches, and if shaded seating and refreshments are available, they may linger after matches to socialize. These players also will appreciate shaded benches between courts and a convenient source of water.

A picturesque area, complete with tables and chairs, situated adjacent to tennis courts, can be a pleasant place to wait for a free court, to unwind after a game, or to watch a match in progress without interfering with players' concentration. This type of setup will be appreciated, especially by recreational and social tennis players. Photo courtesy of Nova Sports, USA.

Social players often enjoy the feel of a tennis garden — two court banks surrounded by pleasant paths and landscaping create an appealing natural environment.

Wheelchair Tennis

According to the USTA, wheelchair tennis is the fastest growing wheelchair sport in the U.S. It is one of the few sports where wheelchair athletes compete with able-bodied players. The game of wheelchair tennis follows the same rules as able-bodied tennis, except the wheelchair tennis player is allowed two bounces of the ball. The first bounce must land in the court; the second can land anywhere.

A regulation court is used. Wheelchair tennis will not harm the court. In most cases, lightweight chairs equipped with soft pneumatic or polyurethane tires are used. Black bicycle tires should be avoided. These tires will leave marks on hard courts similar to those left by black-soled shoes.

The Americans with Disabilities Act, as well as various state and local codes, require that all public facilities, including tennis facilities, be accessible to both players and spectators in wheelchairs. Be certain to check requirements in all relevant codes when planning a facility.

At least one court must be fully accessible in all facilities; more may be required if the facility is especially large. Paths to and from courts must accommodate wheelchairs. A path width of at least 36" (914mm), with occasional wider areas for turning and passing, is recommended. The surface of any accessible path must be firm and non-slip in all weather conditions. Accessible gates into courts and/or doorways into tennis enclosures, restrooms and spectator areas must be at least 36" (914mm) wide. A wheelchair is not normally wider than 30" (762mm) but wheelchairs designed for tennis may have as much as 14 degrees of camber, making them 34" (863mm) to 42" (1.06m) wide at the widest point (where the rear wheels meet the ground).

Curb cuts may be necessary and ramps must be provided in any area with an abrupt change in level requiring a step up or step down. The maximum allowable slope for such ramps is 8% (1:12). Drinking fountains, locker rooms, rest rooms and other player/spectator amenities must comply with federal, state and local codes on accessibility. Adequate parking for persons with disabilities must be provided and marked with the international access symbol. Accessible parking spaces should be located along the shortest accessible path to an accessible entrance to the facility. In addition, plan on providing a passenger loading zone with an accessible area at least 48" (1.219m) wide.

Wheelchair tennis is usually played on hard courts, but some soft courts have been used successfully. Grass courts, however, are not suitable since wheels do not roll well on grass. Clay and fast dry surfaces may be used, but should be somewhat dryer than normal for wheelchair play. Concrete and asphalt courts are the ideal surfaces for wheelchair play. A slow surface is recommended. If asphalt courts are used, care should be taken in extremely hot weather when such courts, particularly recently constructed courts, may soften. Under these conditions, the front wheel casters of wheelchairs may mar the surface.

In designing facilities which may be used for wheelchair tennis tournaments, two additional issues should be considered. Since tennis chairs are quite wide, players often bring their regular chairs to use when entering shops, restaurants, etc. This means that one chair will need to be stored while the other is in use. A major wheelchair tournament may attract 100 to 200 players, up to 70% of whom will bring two chairs. A tented area may be used for temporary chair storage. In addition, plan for a large number of wheelchair spectators. This means paths should accommodate passing chairs and a larger than average number of wheelchair-accessible parking places, restrooms, etc. will be required.

Children

The playing fields and equipment for many sports have been modified for small children to insure immediate success. In tennis, beginning adults and children often play on half court using just the four service boxes. A better adaptation is short tennis. Short tennis is played on a court 18' (5.48m) - 20' (6.10m) wide and 40' (12.2m) long, compared to 36' (10.97m) wide and 78' (23.77m) long, using a racquet 18" (457mm) to 25" (635mm) long, compared to the standard 27" (686mm). Paved areas, gym floors, packed dirt or flat grassy areas are all suitable for short tennis courts. Temporary lines can be taped indoors or chalked outdoors. In lining out courts, allow at least 6' (1.82m) at the end of each court and 6' (1.82m) between courts, if possible. Most often, however, courts are created by dividing a regulation tennis court into four adjacent short tennis courts. Regulation sidelines become baselines, while regulation baselines and service lines act as sidelines.

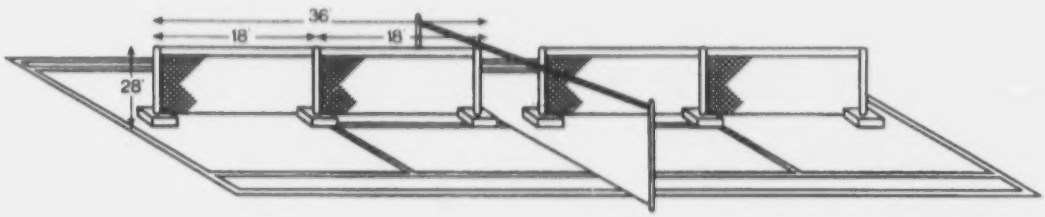
Commercial nets and standards for short tennis are available. Existing standards for volleyball or for other net games work fine. Any lightweight net that will cover the 18' (5.48m) - 20' (6.09m) width is suitable. A badminton net is fine or it is possible to improvise with a rope and streamers. The net should be about 30" (762mm) high at the center.

Small racquets work best. These may be racquetball racquets or junior tennis racquets. Foam balls are preferred for indoor use and low compression balls (or dead or punctured tennis balls) for outdoor use, since foam balls get out of control in even a light wind.

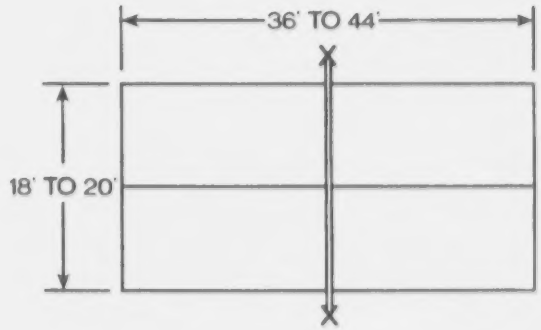
The advantages of a modified court and equipment are numerous. The smaller size makes efficient use of facilities by putting more beginning players (whether adults or children) on the court. At the same time, it appears that beginners have more success learning the game and are able to "play" almost immediately on the smaller court. Short tennis is very popular and widely used in Europe. Experience there and in USTA pilot programs indicates that the skills learned in this modified game are easily transferable to regulation tennis.

The Ideal Tennis Court

Each tennis facility has its own unique needs, conditions and problems. This entire manual is an effort to help an owner juggle those factors, each in relation to the others, to create the best possible facility under those particular circumstances. However, many owners ask, what makes for an "ideal" tennis court. The following are some of the factors which should be considered:



DIVIDING A REGULATION TENNIS COURT INTO FOUR SHORT TENNIS COURTS



A SINGLE SHORT TENNIS COURT

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The Court

1. The court, regardless of the type of surface, should be constructed to the highest standards. In constructing the court, particular attention should be paid to drainage, soils and subbase construction since a quality surface can only be constructed on a quality base.
2. The playing area should be 60' (18.288m) x 120' (36.576m) long. The space over the court should be free from obstructions and no buildings or trees should cast shadows on the surface.
3. When built in multiples, each court should have individual access. There should be no more than three courts in a battery, spaced 24' apart. There should be fencing dividing or partially dividing adjacent courts with a shade shelter to provide player seating and storage between courts.
4. The court should be oriented with the long axis north and south or slightly northwest and southeast, depending upon the latitude in which the court is constructed.
5. Water flowing from higher ground should be intercepted prior to reaching the court.
6. The court should be constructed in one continuous plane, sloped according to the type of construction, with water draining across the court. There should be no "birdbaths."
7. The court color should be non-glare, aesthetically pleasing and contrasting with the ball.
8. The court should perform and play uniformly across its entire surface.
9. The lines should be accurately marked in accordance with the Rules of Tennis and should provide bounce consistent with the remainder of the court.
10. The surface should be free of cracks, peels, bubbles or other irregularities.

Court Equipment and Accessories

1. Net posts of durable finish with an internal net tightening mechanism should be provided. They should support the net at 3'6" (1.067m). The foundations should be at least 3'6" (1.067m) deep, wider at the base, round at the top and flush with court. Singles sticks (or singles net posts) should be provided and their location should be marked on the court surface.
2. The net should be well-made and sturdy, held down with a center strap to a height of 36" (914mm) above the court surface. The net should be set-up by the weight method to achieve a tension of approximately 500 lbs.
3. Fencing should be vinyl coated or painted a medium or dark color for contrast. It should be 10' (3.048m) to 12' (3.658m) across the back of the court and 20' (6.096m) to 40' (12.92m) up the sidelines with the middle area up to 40' (12.192m) on either side of the net left open or filled in with 3' (914mm) fencing. Fence mesh should be 1 3/4" (44mm) diamond pattern to prevent balls from sticking. Fence posts and their foundations should be strong enough to resist winds and ice if common in the area.
4. Sub-surface irrigation systems should be installed for fast dry and clay courts.
5. Maintenance equipment and storage should be conveniently located.
6. A good lighting system, providing no less than 50 foot candles average maintained illumination within the principal playing area with a maximum uniformity ratio if 2:1, should be installed. The light poles should be installed outside the playing area and outside the fencing.

Other Amenities

1. A hose bib should be provided for maintenance purposes and electrical outlets should be provided for maintenance and for accessories.
2. A drinking fountain, clock, ball machine, ball retriever, backboard or practice wall, covered trash receptacle, windscreens, telephone and umpire chair should be considered, as appropriate, for planned use of the court.
3. A tennis house with a washroom, first-aid supplies and refrigerator enhances the court.

Environment

1. Space should be provided around the court for lawn and for comfortable, shaded spectator seating with a good view of the court.
2. Landscaping should be aesthetically pleasing. Functionally, it should provide good background for play, screen distractions, block the wind and provide privacy.
3. There should be no distracting activity, particularly at the ends of the court, and no undesirable noises to divert the players' attention. Players must be able to see the ball clearly against the background and to hear the ball come off their own strings and the strings of their opponents for maximum enjoyment of the game.
   Players leaving the court to retrieve balls should not be at risk from any hazard and should not need to intrude on neighboring property.
4. The court should be secure from misuse and players should be safe when accessing and using the facility.
5. The court should be clean and well maintained with a regular maintenance and cleaning schedule in place.

Chapter III

The Construction Process

1000	A / E Selection	20
Ramp		
1080	Construction Price Verification	0
2000	Schematic Design	31
2010	Design Development	30
2020	Construction Documents	66
2050	Ramp Construction	276
Ice Arena		
2075	Construction Price Verification	0
2080	Focus Meetings	15
2040	Seating Capacity Expansion	0
3000	Schematic Design	52
3005	Structural & Exterior Veneer Systems Selection	0
3010	Design Development	30
3015	Owner Approval	0
3020	Construction Documents	87
3050	Ice Arena Construction	234
Tennis Courts		
3080	Construction Price Verification	0
3090	Focus Meetings	15
4000	Schematic Design	40
4010	Design Development	22
4020	Construction Documents	64
4050	Tennis Court Construction	102
Outdoor Tennis Courts		
5000	Schematic Design	10
5010	Design Development	22
5020	Construction Documents	44
5060	Outdoor Tennis Court Construction	43
5040	Outdoor Tennis Court Construction	86
		435

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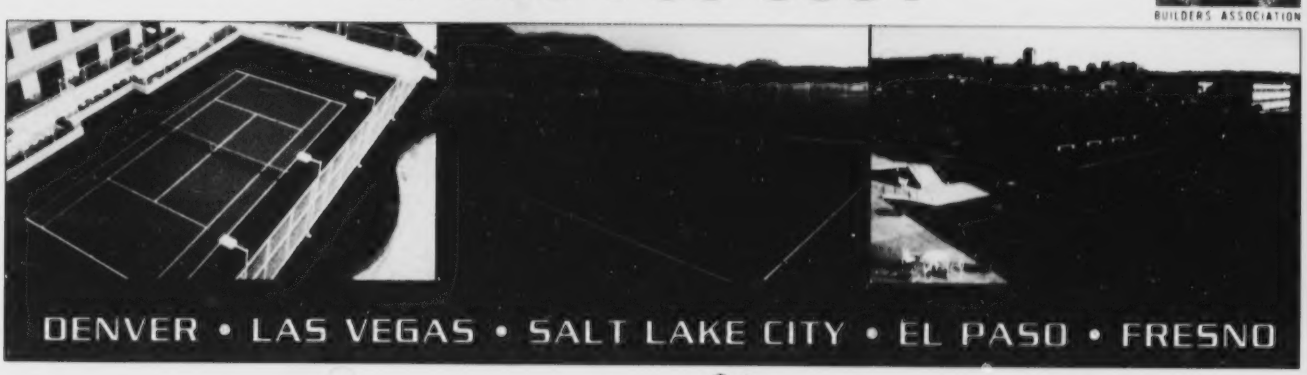

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The Construction Process

Once all the planning and design decisions have been made, a surface and planned accessories and amenities have been chosen, the actual construction process begins. This chapter will describe that process so that the owner will have an idea of the stages in the process and what to expect during those stages.

Permits, Codes, Authorities

A properly zoned site must be available for construction of any tennis facility. As described in Chapter II, an appropriate site must be large, preferably level and well-drained, and as high or higher than surrounding ground. It should have good access and be located within 15-20 minutes driving time from the tennis playing population it will serve. It isn't easy to find such a site.

Owners are cautioned not to purchase the site, however, until zoning and permitting have been investigated. All too often, owners purchase a site only to learn the facility planned cannot be built on that site because of zoning or permitting limitations. Any possible variance or special exception which must be obtained from local, municipal or state governments or from property owners associations should be considered. Rather than delaying a project, appropriate investigation before purchasing a site can prevent expensive and time-consuming problems later.

Once the site has been purchased, site preparation, excavation and building permits, if required, should be obtained. Local codes should be considered including the type of zoning, fence location and height, erosion control and drainage considerations, flood plains, access roads, parking requirements, utilities and setbacks. Conservation, wetlands and historic preservation regulations may affect some sites. An environmental impact statement may be required. The municipal or county clerk's office usually can provide information regarding which permits and regulations affect the site. Permits often require certified surveys or stamped architectural drawings. The contract documents should specify whether the owner or the contractor is responsible for securing the proper permits. This process can be time-consuming. Be certain to allow adequate time for permitting, with delays, in the project schedule.

Selecting a Tennis Court Designer or Consultant

Since building, repairing or remodeling a tennis facility is not only relatively expensive, but a long term investment, special care should be taken in choosing the professionals involved in the project. While construction of a tennis court does not always involve the use of a professional designer such as an architect, landscape architect or engineer or a tennis facility consultant, there are many instances where the advice and experience of a licensed

design professional and/or a consultant experienced in tennis court construction may be useful. These instances are referenced throughout this book; however, among the factors which may necessitate the input of a design professional are:

1. Proper dimensions and spacing between and around courts, particularly on irregular or limited sites or where liability issues are a special concern;
2. Orientation of courts, site layout and planning;
3. Drainage including slope and drainage of courts, site drainage and storm water management;
4. Soil issues, base construction;
5. Evaluating surfacing options;
6. General information, advice and comparison of accessories and amenities;
7. Climatic considerations; and
8. Tennis courts built on decks, rooftops or anywhere above grade.

If at all possible, choose a project architect or engineer with experience in designing tennis facilities. He or she should completely understand the rules of tennis as they relate to facilities, USTA recommendations with regard to tennis courts and the construction guidelines of the USTC&TBA. In addition, he or she should be knowledgeable about zoning, permitting, soils, environmental issues, accessibility, and drainage. He or she should demonstrate the ability to prepare quality bidding documents.

If the project architect, engineer or landscape architect is not experienced in tennis court design, the use of a tennis court consultant to work with the designer is highly recommended. Consultants also can assist in conducting feasibility studies, recommending features to be included in a project, suggesting the best design and utilization of space to accomplish programming objectives, evaluating surfaces, accessories and amenities to meet the owners' needs and budget, supervising construction and authorizing payments.

How can an owner find a qualified tennis court designer or consultant? One way is to consult the USTC&TBA. The USTC&TBA offers a directory of its members, including design professionals and experienced consultants. A searchable database also is available on the USTC&TBA website. See "Choosing a Contractor" below for other ideas on finding and evaluating designers and consultants.

Specifications

Next, draft specifications for the project. The more precise and detailed the specifications for a given project, the more likely that prospective builders will submit comparable bids. Specifications should outline the scope of work, including labor and materials to be provided. They should clearly indicate whether particular materials are required or whether substitutions or equivalents are acceptable. Specifications may also detail the amounts of materials to be used, the equipment to be used, the methods of application or installation of materials and the transportation necessary to complete the work described. The scope of work may be defined as all or only part of a given facility project. The USTC&TBA can provide construction guidelines for use in drafting specifications. These guidelines are available at no charge on the Association's web site at ustctba.com. For some projects, it may be advisable to utilize a design professional or consultant to assist in developing specifications. Often drawings of the proposed court facility, as well as the necessary construction details, are included with the specifications to provide further information and clarification. Typically, drawings are provided by a design professional.

Bid Process

A private owner may research potential contractors in advance and invite only qualified contractors to bid on the project. Public projects, however, often are subject to open bidding. The public owner may choose to pre-qualify contractors on the basis of experience, financial strength and similar issues.

Once the bids have been submitted, they should be carefully compared. It may be helpful for the owner to develop a checklist. The owner should note any inconsistencies between bids and should question bidders to insure that each bid reflects the requirements noted in the specifications.

An owner should be especially careful with a very low bid or a very high bid. It is appropriate to question the contractor or to invite the contractor to review the bid.

Contract Documents

The contract documents will consist of the construction contract, the conditions of the contract, drawings (if required) and specifications. While the specifications will explain in detail the work to be performed and how it is to be performed, the contract may include other agreements regarding the relationship between the owner and the contractor. These might include an acknowledgment that the contractor has visited the site and is familiar with the local conditions under which the work will be performed, a schedule for the intended work, requirements for payments and insurance, responsibility for permits, taxes, electrical power and water, and similar issues.

Choosing a Contractor

Choosing the right contractor can determine the ultimate success of a tennis facility project. A knowledgeable and experienced contractor can help the owner make the right decisions resulting in a quality project. Tennis court construction is a highly specialized field within the construction industry. It is vital that the contractor chosen be familiar with current products and construction techniques, as well as with the type of surface to be installed.

How can an owner find a qualified contractor? One way is to contact the USTC&TBA. As the trade association for tennis court builders, the USTC&TBA can provide a directory of its member contractors. In addition, the USTC&TBA conducts a certified builder program. Experienced contractors earn the Certified Tennis Court Builder (CTCB) designation by completing a specified number of projects and by passing a certification examination. The Association also conducts an inquiry program, requesting information on behalf of owners from contractors and suppliers.

Another way to find a contractor is to look in the local *Yellow Pages* under "tennis court construction." Only a small number of contractors consider themselves specialists in athletic and recreational facilities. Trade industry magazines also may be helpful; specialty contractors frequently advertise in such publications. A listing of such periodicals is included in Chapter IX. Finally, an owner can contact tennis clubs, municipal facilities and schools, as well as individuals, who have recently completed tennis court projects, asking whether or not they would recommend their contractor. Other questions to ask include whether or not the job was completed on time, whether it met the owner's expectations and whether there were any hidden costs. The owner also might ask whether the contractor was able to solve any problems which arose during construction, how the court is performing, whether there have been any post-construction problems and if so, whether the builder was responsive in taking care of them. Ask how the court looks and how it plays.

Both experience and reliability of the prospective builder are important. An owner should consider the following:

How many years has the company been in business? If it is a relatively new company, what is the work experience of its principals? How many courts have they built? Were they responsible for the complete project, just for surfacing, just for site work? An owner should look for individuals or for a company with specific knowledge and experience in tennis court construction.

Does the company have experience in the type of project contemplated? Has it built residential courts or club projects, hard courts or soft? An owner should look for a company with experience in projects similar in size and scope to the project planned.

Ask for references and for a complete list of recent projects. If a significant project is omitted from the list of references, there may be a reason for that omission. Call references and ask questions. Determine as much information as possible about a prospective contractor's knowledge, experience, workmanship, ability to meet schedules, financial responsibility and accountability. If possible, visit completed projects and talk to owners.

Get references from design professionals, subcontractors, bankers and bonding companies.

Ask about a contractor's insurance; have there been any major accidents or claims against the builder?

Ask about awards and recognition. Has the contractor won any awards for his work? Is he or his company certified or accredited by any trade organization?

Check on lawsuits. If the contractor has been or is currently involved in litigation, find out the details. Check with the local Better Business Bureau, or with any local licensing agency, for consumer complaints.

Ask to meet the individuals who will be involved with the project, particularly the job superintendent. Does the contractor/superintendent seem knowledgeable about size requirements, orientation and slope of tennis courts? Does he understand grading, drainage, site preparation and base materials? Is he familiar with different tennis court surfaces? Can he make recommendations regarding specific court surfaces to meet the owner's needs? Is he familiar with amenities and accessories including fencing, lighting, nets, net posts and windscreens? Is he a Certified Tennis Court Builder (CTCB) or a member of the U.S. Tennis Court & Track Builders Association? What is his current workload? Can he realistically handle the project within a reasonable time frame?

Consider communication. The owner will want a contractor who listens and responds to his needs. The contractor should be someone with whom the owner feels comfortable, someone with whom the owner can establish rapport. The owner will want a contractor who will build the facility the owner wants, not one who will build a standard court and move on. Don't underestimate the value of a good working relationship.

Ask for proposals in writing and compare them carefully. Ensure that the bids, including products to be used and methods of construction, are identical to your specifications. What is included and what is not included in the contract price? Who — contractor or owner — is responsible for such items as permits, site preparation, electric power, taxes, insurance, removal and replacement of trees and shrubbery, or restoration of the construction site access route? Such items, while essential to the project, may or may not be included in the bid; whether or not they are included can significantly affect the contract price and the overall project cost. Even if construction materials and methods are identical and items included in the contract are consistent, look beyond price when comparing proposals. Compare proposed construction schedules, progress payments, and most important, guarantees and warranties. Understand what is included in any guarantee — materials,

workmanship or both — and for how long. Rank the proposals and then attempt to negotiate a contract with the first choice builder. While price is not the only consideration, if the bid of the preferred contractor seems high, ask the contractor to review the bid or try to negotiate additional services into the package to make the higher bid more attractive.

Once a contractor has been chosen, confirm the agreement in writing. The contract documents, signed by both owner and contractor, should be as specific as possible and should include, where appropriate, an agreement, conditions of the contract, drawings and specifications defining the scope of work including labor, materials, equipment and transportation to produce the project.

Overview of Construction

Site Investigation

Site investigation includes determining the size of the facility that can be constructed and orienting the project on the site. Topography, drainage, soil conditions, access, orientation, availability of utilities and site restrictions, all must be considered.

Site investigation also includes identifying the soil conditions existing at the site and insuring that those conditions are considered in the specifications for the project. To achieve proper grading and consistent compaction, appropriate subbase conditions are required. Sites with expected or confirmed concerns regarding drainage and soil conditions may require a geotechnical survey.

For information on site investigation, see Chapter II.

Site Preparation, Grading, Compaction and Drainage

Site preparation includes stripping the site of vegetation to a minimum distance of 5' (1.524m) beyond the surfaced area. The topsoil should then be removed to a distance of 5' (1.524m) beyond the surfaced area. Topsoil should be stockpiled at the site and used for landscaping at the completion of the pavement construction and prior to final court surfacing.

Next, depending upon the existing grade, high areas may need to be excavated or low areas filled to establish an appropriate grade. Excavation and/or fill will add to the cost of construction and to the time required for construction. However, it is important to provide a proper grade for the court and for the surrounding area. The appropriate grade carries the water away from the court and other critical areas while blending the court into its surroundings. Grading is a must to avoid erosion and the need for excessive ongoing maintenance. In establishing the grade, the subbase material must be compacted. Care must be taken to insure that the subbase is compacted uniformly over the entire site.

Establishing subsurface and surface drainage is the next step in construction. Subsurface drainage, if required, usually involves the construction of an interceptor drain (sometimes called a "French drain") around the perimeter of the planned facility to serve as a barrier between the facility and approaching water. Surface drainage collects and redirects surface water. Water collected in both subsurface and surface drains must be moved away from the facility to an appropriate disposal site.

For more information on site preparation, excavation and fill, drainage and subbase construction, see Chapter II.

Constructing the Base

Clay, fast dry, asphalt, reinforced concrete and post-tensioned concrete courts are built on a base of crushed stone or screened gravel. The thickness of the base course will vary, depending on local soil and climatic conditions and on the type of court to be constructed. Once installed, the base is compacted and fine graded to establish the finish slope for the surface. The surface of the base course, after compaction, must be smooth, even and should not vary more than 3/8" (10mm) from the true plane of the court.

For more information on construction of base courses for various surface types, see Chapter IV.

Constructing the Surface

Next, the surface is constructed or installed, often in several lifts, depending upon the type of surface. Footings for net posts, fencing and light poles are constructed prior to or during the construction of the surface, depending on the type of surfacing. Hard courts, including asphalt, reinforced and post-tensioned concrete, must then be allowed to cure before they are coated.

If a color coated or cushioned hard court is planned, landscaping and finish site grading should be completed prior to installation of the color or cushion coating since such work may cause damage or staining to the coated surface.

Installing Fencing, Lighting and Other Amenities

Once the court itself, or the courts in the case of a larger facility, are completed, fencing, lighting and other amenities are installed. Again, with hard courts, all fencing, lighting and amenities should be installed prior to the color or cushion surface to avoid damage.

Construction Timetable

The time required to construct a tennis facility depends upon the permits required; site conditions, especially the need for excavation and/or fill; the size and complexity of the facility under construction; the type of surface being installed; the resources and current workload of the contractor; and the weather during the period of construction.

Planning, design and permitting may take as little as a month or two or as much as several years, depending upon the size, scope and location of the project. As a general rule, permitting may take 30 - 90 days while the bid process may take an additional 30 - 60 days. Projects should not be bid before permits are obtained because revisions required by local authorities may lead to costly change orders.

For a single soft court, an owner can count on an actual construction period of up to one month after permitting and bidding is completed. An asphalt court will take somewhat longer, perhaps six weeks. Concrete court construction will take about the same time as construction of an asphalt court, except that the curing time for the concrete slab will be approximately four weeks, resulting in a total construction period of up to eight weeks. The chart on construction time tables shows typical construction schedules in good weather at an average site.

Construction will be delayed by bad weather, especially rain. Overcast skies and cooler temperatures, even without rain, will increase the curing time of asphalt courts. Concrete, however, cures chemically. In fact, rain is advantageous and does not retard the curing process. In any case, at a minimum, any court construction schedule should anticipate at least 3 - 5 days of lost time due to poor weather or other unforeseen construction difficulties.

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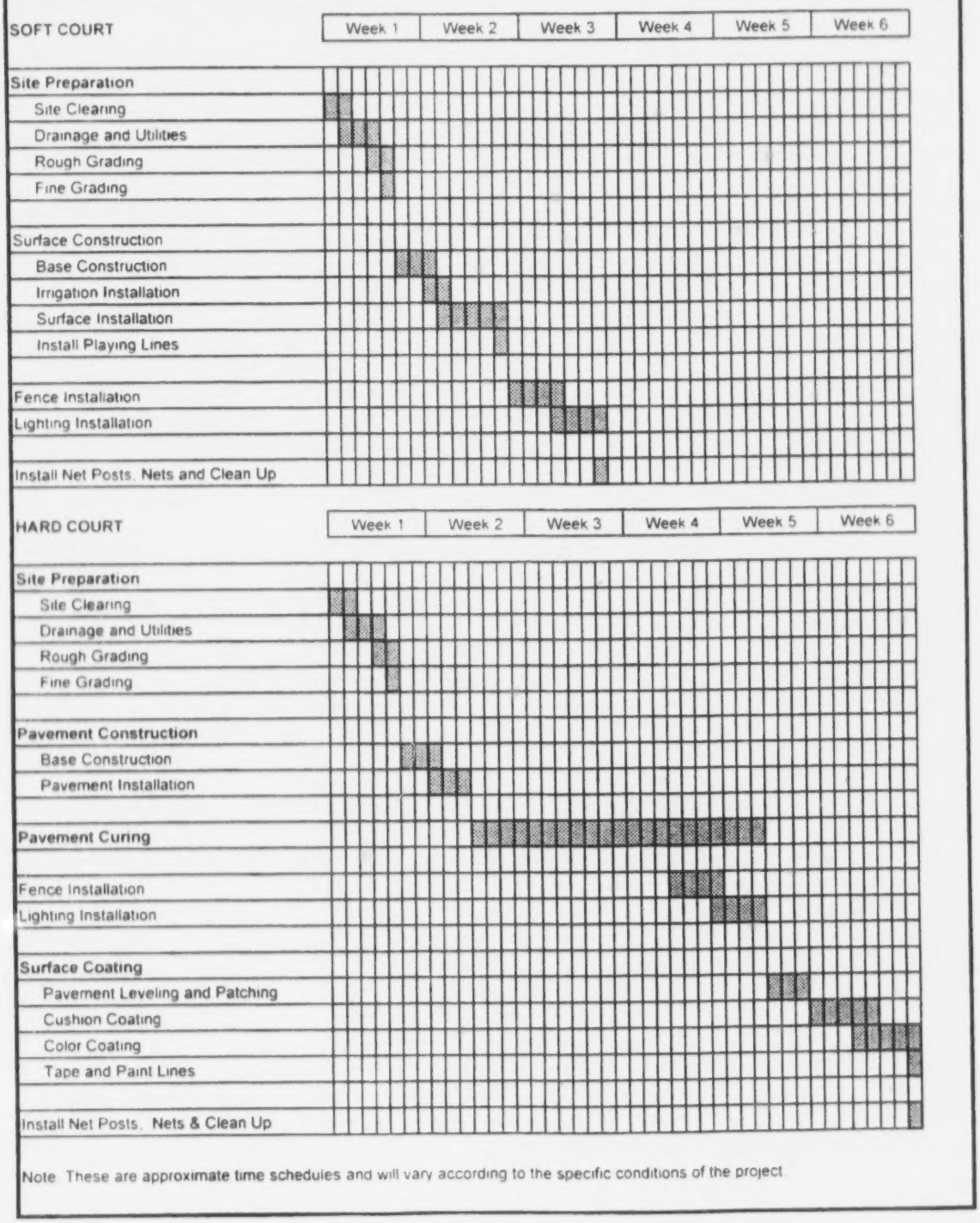
Typical Court Construction Time Tables



Note: These are approximate time schedules and will vary according to the specific conditions of the project.

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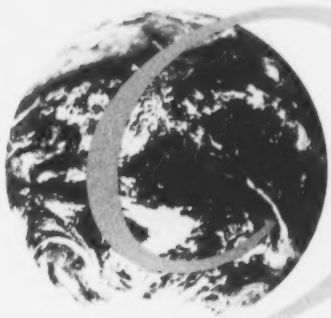
Chapter IV

Choosing a Surface

WHERE CAN YOU FIND THE WORLD'S BEST SPORTS SURFACES



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Choosing a Surface

One of the most important decisions in planning a tennis facility is choosing a surface. There are numerous factors to consider. When installing an outdoor court, the geographic location will play a major role. The Northeast and the Midwestern areas of the country are subject to multiple freeze-thaw cycles throughout the winter, as well as hot, sometimes humid summers. These factors can limit the tennis season and affect the construction, maintenance and useful life of courts. In Western areas, sun will be the enemy of the court, bleaching out the color of a hard court, and drying a clay or fast dry court. Warmer, more humid areas such as Florida and the Southern states, will offer a year-round tennis season, but also may bring about algae or mildew problems.

Intended use and player preferences should be a major consideration. What type of players will use the court and how often will they be playing? What type of tennis game do they prefer? How willing are players to provide court maintenance such as brooming or rolling? How careful are players about the surface? Are players looking for a court year-round? A properly designed tennis court will fit the players' needs, interests and style of play.

Surface choice may be affected by short and long term costs. The cost of construction of a given type of court will depend on site conditions, availability of materials, local contractor experience and similar factors. Long term costs are influenced by the amount of maintenance required and the expected useful life of a surface.

The amount and frequency of repair will vary from surface to surface as well. Surface cracking and peeling in all-weather courts, uneven texture resulting from packed sand in sand-filled turf systems, frost damage to clay and annual resurfacing of fast dry courts, all are examples of common maintenance requirements for various types of tennis courts. Some can be easily and inexpensively repaired, while others will require more expensive and time-consuming maintenance or repair procedures.

The availability of certain materials and equipment may be limited, depending upon the location of the court. Similarly, depending on the location, there may or may not be contractors skilled in certain types of court construction. Finally, site conditions, such as subbase soils and drainage may affect the suitability of a specific surface.

Drafting Pavement and Surface Specifications

Once a surface is chosen, an owner should draft specifications for both the pavement, where applicable, and the surface with the assistance of a surface manufacturer, a design professional, a tennis court consultant and/or a qualified contractor. The more specific and detailed the specifications, the more likely it is that prospective builders will submit comparable bids.

Specifications should outline the scope of work, including subbase and base preparation, surfacing system and materials, hardware and whether particular materials are required, or whether substitutions or equivalents are acceptable. Specifications also should detail the types and amounts of materials to be used, the methods of application and the acceptable tolerances in the finished court. The USTC&TBA can provide construction guidelines for use in drafting specifications for a project. For larger, more difficult or more complex projects, it is generally advisable to utilize the services of a design professional or tennis consultant to assist in developing specifications.

Classifying Tennis Courts

There are a number of ways to classify tennis courts. The U.S. Tennis Court & Track Builders Association (USTC&TBA) classifies court surfaces technically as follows:

I. Porous Construction - water filters through the surface
   A. Fast Dry
   B. Clay
   C. Natural Grass
   D. Sand-Filled Synthetic Turf Over Porous Base
   E. Porous Asphalt
   F. Porous Concrete
   G. Modular

II. Non-Porous Construction - water does not penetrate the surface but runs off
   A. Non-Cushioned
      1. Reinforced Concrete
      2. Post-Tensioned Concrete
      3. Hot Plant Mix Asphalt
      4. Asphalt Penetration Macadam
   B. Cushioned
      1. Polymer Bound Systems
      2. Textiles
      3. Sand-Filled Synthetic Turf Over Non-Porous Base
      4. Portable

Tennis players, however, more commonly classify tennis courts as "soft courts" and "hard courts." Soft courts include clay, fast dry, grass and sand-filled synthetic turf. They are quite popular with players because they are easy on players' feet, backs and legs and they generally provide cool, glare-free surfaces. Fast dry, clay and grass courts are less expensive to construct than hard courts in most parts of the country, but they require regular care and, for clay and fast dry courts, annual repair and/or resurfacing. Also, fast dry courts may require daily maintenance and watering. Sometimes this is accomplished by means of a subsurface irrigation system incorporated in the construction. Soft courts are easily damaged, but also easily repaired. In colder climates, these courts must be closed for the season when the ground freezes.

Hard courts include asphalt and concrete courts surfaced with acrylic coatings or covered with roll or sheet goods or modular surfaces. They generally require less maintenance and hold up somewhat better to the abuse and misuse which seem inevitable when courts are unattended. Properly installed, hard courts are generally considered to be durable and to require relatively low maintenance. Hard courts may offer a longer playing season in cold climates. Even in the midst of winter, they may be available for play on any warm day and play resumes earlier in spring and continues later in fall than on soft courts.

Manufacturers often refer to a court surface as resilient (cushioned) or non-resilient (non-cushioned). When a resilient layer (or layers) of material is applied over an asphalt or concrete court, a cushioned court results. Cushioned courts provide an all-weather surface for year round play, while softening the effects of pounding from running on a hard surface. The benefits of cushioning are most noticeable after long matches or with frequent play. These attributes make cushioned courts popular with players, but these courts are considerably more expensive than conventional hard courts. Also, it should be noted that cushioned surfaces can be more easily damaged by street shoes and play equipment such as skateboards, in-line skates and hockey sticks.

Players also classify courts by their speed. The speed with which balls come off the various surfaces and the relative effect of the surface on ball spin produces another grouping — slow, medium and fast. These terms relate to the reaction of the ball hitting the surface, specifically the angle at which the ball comes off the surface. When the surface causes the ball to skid and the angle of the ball coming off the surface is lower than before the bounce, the surface is described as "fast." A surface on which the ball comes off the surface at the same angle as before the bounce is described as "medium." A surface on which the ball comes off the surface at a higher angle after the bounce is described as "slow." Generally, the rougher the texture, the more the surface will grip the ball and the slower the surface will play. Also, the rougher the texture of the court, the more effect will be evident from spin placed on the ball by the player.

On hard courts, the speed of the surface and the effectiveness of spin is controlled by the size and quantity of sand or rubber particles mixed with color coating. When cushioning is added to a hard court, to a limited degree, the thickness and density of the cushioning affects the speed of the game. Thicker and less dense cushioning absorbs ball energy, providing a slower, lower bounce. Less thick or denser cushioning provides a quicker, higher bounce. Textured color coatings applied to the resilient surface of cushioned courts can regulate the speed of the surface as well.

With the exception of grass and synthetic turf, soft courts produce medium to slow play. However, the speeds of fast dry courts can be regulated to some degree by maintenance practices and the choice of surfacing materials. Grass and synthetic turf courts are considered fast since the ball skids low, giving a player less time to make a shot.

The ideal court speed depends on the type of player. Players with a strong serve and volley game usually will opt for a medium fast to fast surface. Baseline players, or those playing strictly recreational or social tennis, usually look for longer rallies and a shot placement/spin type of game. For them, a medium to slow court is recommended.

Soft Courts

Soft courts are quite popular with most players because they are easy on players' feet, backs and legs. In tennis, player injuries and fatigue most often are caused not by pounding, as in running or aerobics, but by quick stops and starts. Soft court surfaces provide some slide, which allows a transfer of energy from the moving player to the surface rather than placing stress on ankles, knees and hips.

With the exception of sand-filled turf installed over a non-porous base, soft courts are porous, meaning that some water passes through the layers of the court and is retained within. For this reason, they generally provide a cool, glare-free surface. With the exception of grass and sand-filled turf, soft courts produce medium to slow play which lends itself to a strategic game. Many club players enjoy this type of tennis.

To some degree, the speed of clay and fast dry surfaces can be adjusted by altering maintenance procedures. Courts which are rolled very firm, for example, will play faster than courts which are rolled less frequently and brushed more.

Chart Comparing Representative Tennis Court Surfaces

Type of Court	Price Per Court on New Construction Including Base (average 1998 - 99)	Maintenance	Repairs May Be Costly	Average Time Before Major Resurfacing	Resurfacing Cost (average 1998 - 99)	Drying Time After Rain	Surface Temperature	Cushioned Surface	Surface Slide	Surface OK Indoors or Outdoors
Porous										
Fast Dry (with above ground irrigation	12,000 - 22,000	daily/yearly	no	5 - 10 years (varies depending on maintenance)	1,500 - 8,000	fast	cooler	no	yes	yes
Fast Dry (with sub-surface irrigation)	20,000 - 40,000	limited daily/yearly	no	8 - 10 years (varies depending on maintenance)	1,500 - 8,000	fast	cooler	no	yes	yes
Clay	12,000 - 18,000	daily/yearly	no	5 - 10 years	1,500 - 5,000	slow	moderate	no	yes	yes
Grass	20,000 - 40,000	daily/yearly	no	varies	varies	medium (varies)	cooler	yes	yes	outdoors
Sand-Filled Synthetic Turf*	25,000 - 35,000	daily/yearly	yes	varies	varies	medium (varies)	moderate	yes	yes	yes
Porous Concrete or Asphalt	15,000 - 35,000	minor	yes	varies	2,500 - 4,000	very fast	can be hot	no	no	outdoors
Non-Porous Non-Cushioned										
Concrete Post Tensioned	25,000 - 40,000	very minor	yes	5 - 8 years	2,500 - 4,000	fast	can be hot	no	no	yes
Concrete Reinforced	25,000 - 40,000	very minor	yes	5- 8 years	2,500 - 4,000	fast	can be hot	no	no	yes
Asphalt Plant Hot Mix	12,000 - 25,000	very minor	no	5 - 8 years	2,500 - 4,000	fast	can be hot	no	no	yes
Non-Porous Cushioned										
Cushioned Asphalt Plant Hot Mix	20,000 - 35,000	very minor	no	5 - 8 years	2,500 - 4,000	fast	can be hot	yes	no	yes
Liquid Applied Synthetic	25,000 - 35,000	very minor	yes	5 - 10 years	2,500 - 9,500	fast	can be hot	yes	no	yes
Textile	30,000 - 40,000	very minor	no	varies	varies	fast	N/A	yes	no	usually indoors
Modular	30,000 - 40,000	very minor	no	varies	varies	fast	moderate	no	moderate	yes
Removable (surface only)	18,000 - 25,000	very minor	no	varies	varies	fast	N/A	yes	no	usually indoors

Note: All prices vary regionally based on construction costs, availability of materials, and freeze-thaw requirements.
Prices include base (except as noted), completed surface, net posts, net and playing lines; exclude site preparation, fencing, lighting, etc.
Prices may be slightly reduced when building or resurfacing multiple courts.

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In some areas, fast dry, clay and grass courts are less expensive to construct than hard courts, but they require more care and annual repair and/or resurfacing. They are easily damaged by hard objects, but they are easily repaired. These courts usually must be closed for winter in climates where temperatures drop below the freezing point.

Clay or Fast Dry Courts

In constructing a clay or fast dry court, a base course of processed stone is installed over the subbase. The thickness of the base course may vary depending on local soil and climatic conditions, but should be not less than 3" (76mm) after compaction, although some residential courts are constructed with a 1 1/2" (38mm) base.

Aggregate used in construction of the base should not exceed 3/4" (19mm) in diameter. Local stone is often used. Granite or a similar type of stone makes an excellent base because, when crushed, it yields angular particles which grip each other creating a stable base which holds water well. Other materials including slag, washed limestone screenings, washed and crushed shells, cinders, sand, pea rock or crushed concrete, also can be used.

The base material must be porous enough to allow water to penetrate after compaction, but not so porous that the water drains completely through. Water should be retained in the base until the court surface begins to dry. Capillary action then pulls the moisture back into the court surface. To insure adequate moisture retention, the base material must have a certain percentage of very small particles, called "fines." Bases with no fines allow too much water to drain through and have no water retention capability. Clean pea gravel, for example, must be combined with other materials to retain sufficient moisture.

The base should be stable enough not to shift under the weight of a roller. Sandy materials often shift when rolled. Beach sand is definitely too unstable, but some concrete sands may be satisfactory. In most cases, sand should be mixed with other materials to provide a stable base.

Some base materials, when combined with water and compacted, become too solid and lose porosity. Some limestone materials become so hard and dense that no water will penetrate at all. Limestone materials should be insoluble and should be checked at the source to insure porosity.

In areas of freeze-thaw activity, cinders, slag and other lightweight materials may heave and should be avoided. Although cinders, in particular, are very porous but retain water well, they deteriorate over time and react with aluminum nails commonly used to affix line tapes. Therefore, they generally should not be used.

After the base course is completed, a leveling course of similar materials not less than 1" (25mm) thick after compaction is installed and graded to the finished slope of not less than 0.28% (1:360) and not more than 0.35% (1:288) for courts with above ground irrigation, not less than 0.14% (1:720) and not more than 0.28% (1:360) for courts with subsurface irrigation.

Under some circumstances, particularly in areas with little freeze/thaw activity, a modified base is constructed consisting of a single course 2 1/2" (64mm) to 4" (102mm) thick. The thinner the base, however, the more critical is the construction and grading of the subbase.

Following construction of the base course or courses, a layer of surfacing material is spread over the top. For clay courts, the surfacing material consists of clay blended with sand and silt. The natural clay should be not less than 25% nor more than 40%, with the remaining material equal parts of sand and silt. The mixture must be thoroughly

blended to a uniform consistency. Its finished plasticity must be not less than 12% nor more than 20%. The surface course should be compacted to a thickness of not less 3" (76mm) for natural clay, 2" (51mm) for blended material and 1" (25mm) for fast dry.

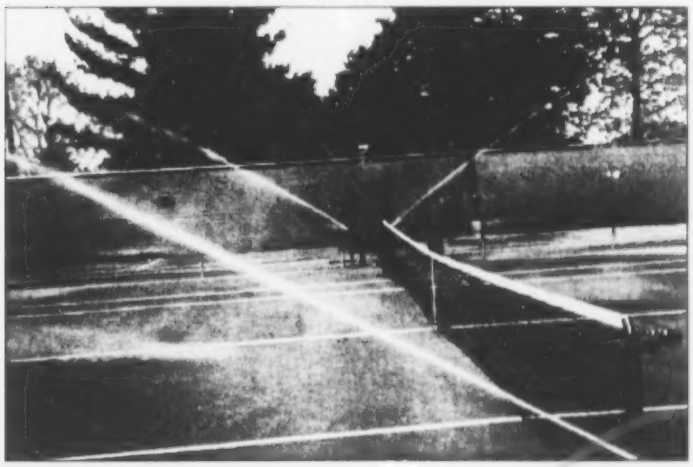
Fast dry surfacing material consists of crushed stone, brick or tile, screened and, sometimes, mixed with a chemical binder. Several name brands are available in the marketplace.

A curb of standard brick or block set in cement mortar, treated wood timbers or concrete is installed around the court perimeter to contain the loose surfacing material. The curb elevation should be 1/2" (13mm) below the finished court surface and the court surface should be tapered from approximately 2' (610mm) out to meet the curb.

A newly constructed fast dry court will hold more water and drain more slowly through the first winter. This is due in part to the binder included in the fast dry material. As the court weathers, the binder leaches out and the court drains more quickly. Another reason the court drains more slowly at first is because it is somewhat soft. No matter how well the court is compacted during construction, it is only through weathering that the particles settle and key together, creating a surface which allows water to run off. A new fast dry court, then, drains almost entirely down through the court; after the first season, most of the water will run off the surface of the court.

Any new court should play uniformly. Over time, as the court becomes worn in areas of heavy use (such as the baseline and net areas), the surface may play slightly differently. Usually only an experienced player will note these minor differences in play.

Both clay and fast dry systems require regular irrigation to saturate the surface; this can be done either through the use of a sprinkler system installed in and around the court, or by a subsurface irrigation system.

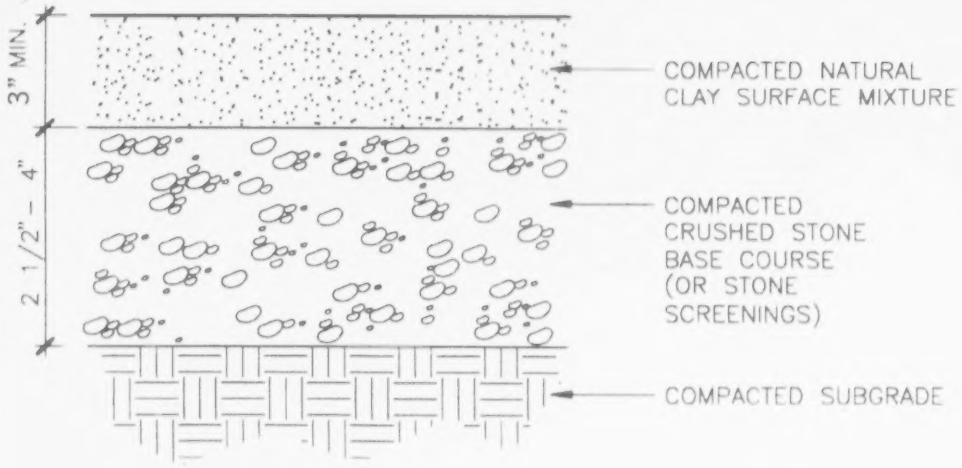


Watering of a fast-dry court is essential to maintain its playing surface. These above-ground sprinklers, situated outside the playing area, keep the surface in good playing condition.

Line markings on clay or fast dry courts are either painted daily or installed for more permanent use with plastic or fabric tapes anchored to the court surface with nails. See Chapter V for more information on clay and fast dry court accessories.

Clay and fast dry courts take more care than hard courts. After each match or after three to four hours of play, a court should be dragged with a seven-foot (2.133m) broom to smooth the surface, and the playing lines should be brushed off. Periodically, depending on the amount of use, the court should be rolled to make sure the surface is evenly compacted to insure uniform ball response. See Chapter VII for more information on maintenance.

NOTE:
RECOMMENDED COURT SLOPE:
MINIMUM – 1" IN 30'
MAXIMUM – 1" IN 24'


3" MIN.
2 1/2" – 4"
COMPACTED NATURAL CLAY SURFACE MIXTURE
COMPACTED CRUSHED STONE BASE COURSE (OR STONE SCREENINGS)
COMPACTED SUBGRADE

TYPICAL NATURAL CLAY COURT SECTIONS

NOT TO SCALE

CLAY –1

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NOTE:
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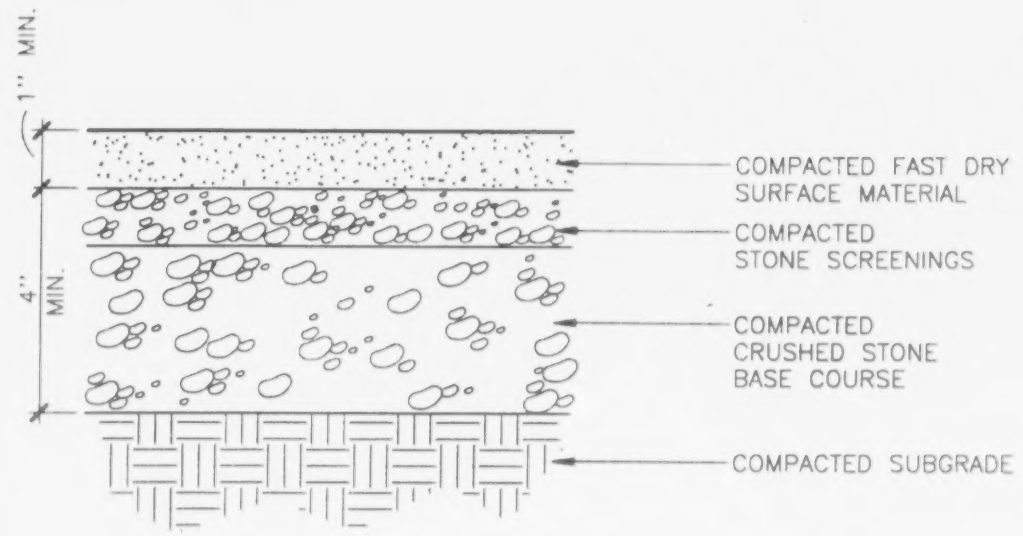
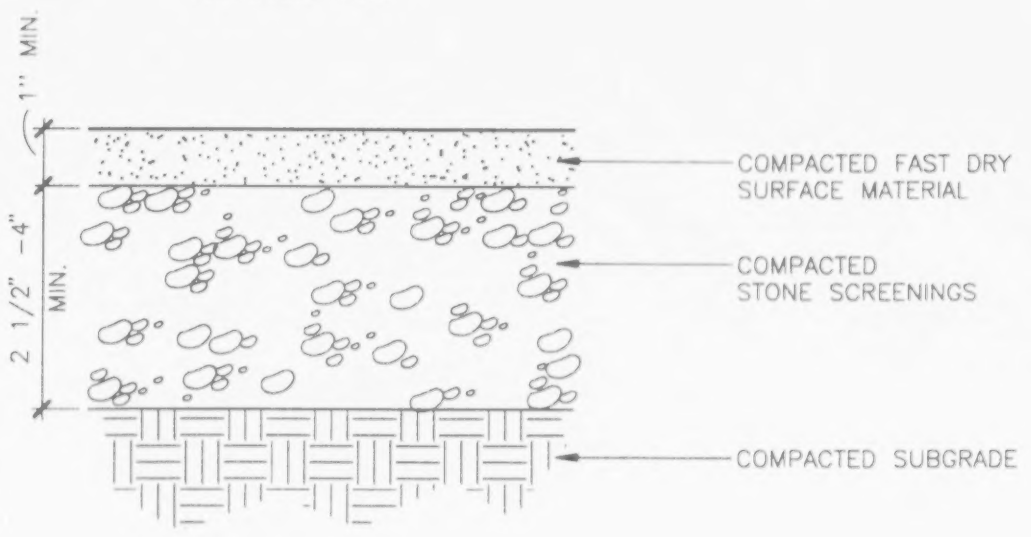
MINIMUM – 1" IN 30'
MAXIMUM – 1" IN 24'



STANDARD BASE



MODIFIED BASE

TYPICAL FAST DRY COURT SECTION

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FDRY – 1

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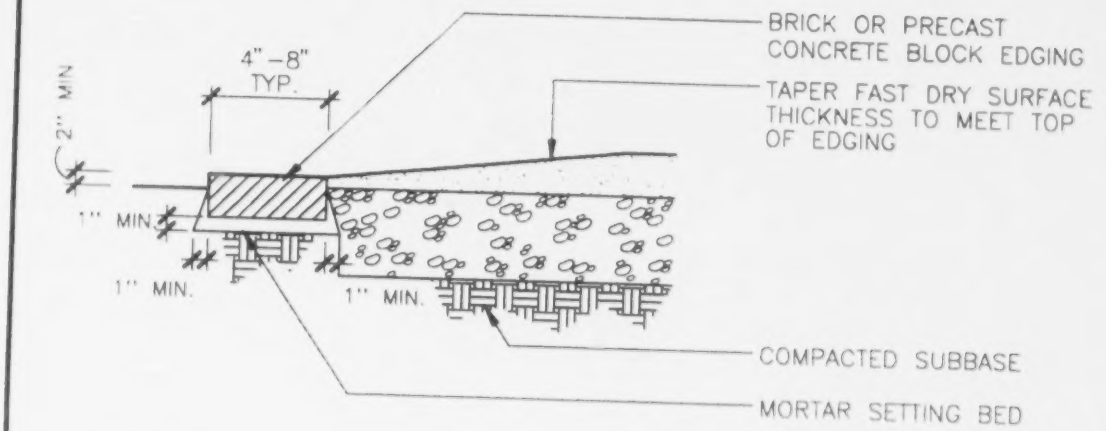
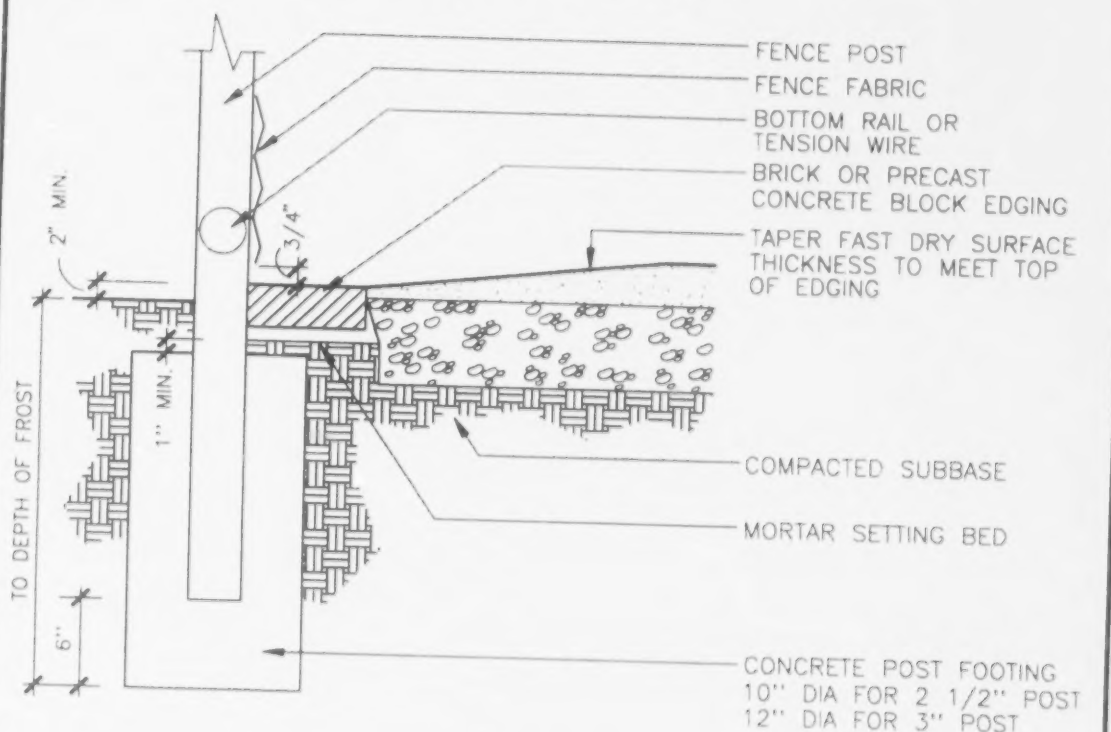


SECTION AT COURT EDGING



SECTION AT FENCE POST

TYPICAL FAST DRY COURT EDGING

NOT TO SCALE

EDGE – 3

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Because freezing conditions, high winds, snow and ice will make this type of court unplayable, it must be closed after the first frost in cold climates. If the owner or maintenance staff is not equipped to take care of the court's seasonal needs, the services of a tennis court contractor may be required to close the facility for the winter and open it again as the weather warms. Spring conditioning will require the removal of old, dead material from the court surface, its replacement with 1 1/2 to 2 tons (1361 - 1814kg) of new material per court, and additional rolling and brooming.

These courts are preferred by many for their enjoyable playing characteristics. The relative lack of friction between a player's shoe and the court surface, and the resulting slide, reduces shock to the knees and ankles when the player stops suddenly or turns. As a result, many players are looking to such courts to expand their playing time into later years and/or to reduce injuries.

Grass Courts

When constructed and maintained properly, a grass court can provide an extremely fast game with a minimum amount of impact to the joints. A tennis ball hit onto a grass court has a low, fast bounce, although the speed of the court can be adjusted somewhat by varying the cutting height of the grass. The court does not retain heat as much as other surfaces and its surface is free of glare.

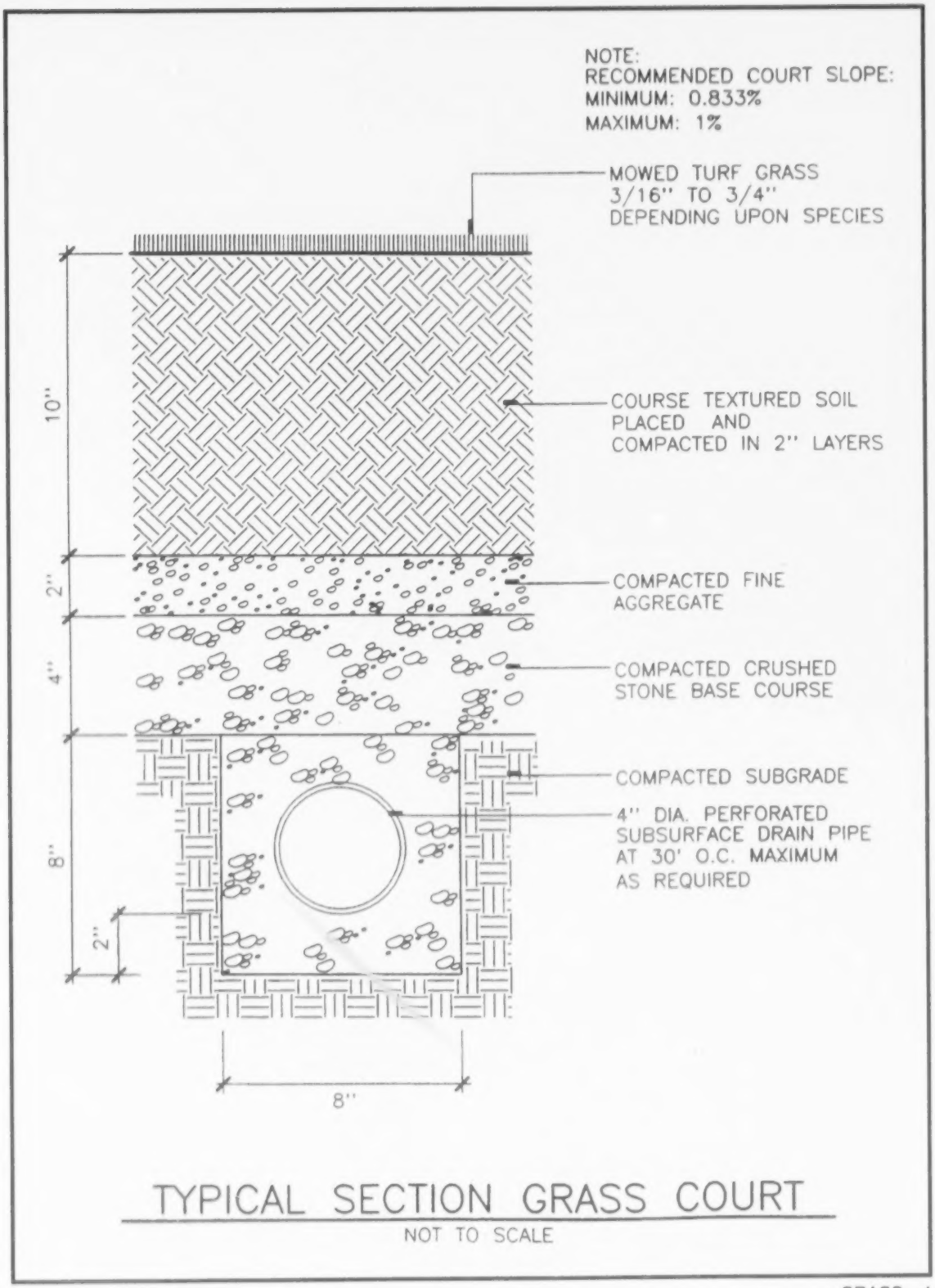
Most of the grass courts in the United States belong to private clubs or are individually-owned. Because climate and soil conditions have a great deal to do with the success of the court, the grass surface is not practical for all areas of the country. Also, daily care and regular maintenance are necessary, and include such activities as watering, top dressing, fertilizing, mowing, and reseeding or sodding the worn parts of the court.

Grass courts are designed to shift position so that players don't wear out the surface in high traffic areas (such as the baseline). Typically, grass courts are shifted daily to allow the lawn to rest. Courts usually are designed to shift laterally (side-to-side) 27' (8.230m) in either direction in order to share the alley lines or longitudinally (front-to-back) 39' (11.887m). This means that the dimensions of the area designed to accommodate one grass court, with appropriate provisions for shifting the layout, would need to be a minimum of 87' (26.518m) X 120' (36.576m) for side-to-side shifting, 60' (18.288m) X 159' (48.463m) for front-to-back shifting, or 87' (26.518m) X 159' (48.463m) for shifting in both directions. Shifting in both directions is preferred to minimize turf wear and damage. For typical grass court rotation patterns, see the drawing in Chapter VII.

Another way to allow the grass to rest is to alternate play on grass courts by using one court one day and resting it the next. This allows for traditional court spacing, but means that only one-half of the courts are available for play on any given day.

In the case of some private residential courts, grass courts are merely lined out on a suitable piece of lawn. Many grass courts, however, are carefully constructed. First, the area is excavated to a depth of approximately 18" (457mm), or deeper if a drain field is to be installed under the court. The excavated area is then filled with 6" (152mm) of dust free aggregate with a diameter of 5/16" (8mm) to 3/8" (10mm). As with fast dry courts, the aggregate used for the base should be angular so that it keys together providing a stable base leaving ample pore spaces for water retention.

Over the gravel, or drainage layer, a binding layer of finer gravel, 3/16" (5mm) to 1/4" (6mm) in diameter, is installed. The binding layer prevents the topsoil from seeping into the drainage layer and blocking its pores. The final 10" (254mm) is filled with manufactured topsoil, a specially blended soil consisting of loam and clay. Such a soil, when rolled and dry, will not crumble or become dusty and will allow water to pass through. The top soil is installed in layers, approximately 2" (51mm) at a time, and compacted as it is installed.



TYPICAL SECTION GRASS COURT

NOT TO SCALE

GRASS – 1

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Once the base has been constructed, the surface can be produced from sod or from seed. When sod is used, care must be taken to insure that the soil in the sod is compatible with the top soil used in the court. Otherwise the surface will not bind to the topsoil layer and the surface and subsurface layers of soil will dry at different rates. Also, if the surface and subsurface soils do not bind, the turf may move. Movement of the sod or delamination of the surface when the sod fails to root and bond properly may result in player injury.

In constructing a tennis court using sod, it also is important not to use washed sod. Washed sod is sod that has had the soil removed from the root system. Washed sod is laid out over a prepared surface and top dressed with soil. This method insures root bonding, but can produce a very cushioned surface which virtually eliminates any ball bounce. Therefore, while useful in other sod applications, it cannot be used in tennis court construction.

While seeding takes longer to bring a tennis court into playing condition, it ensures that the turf is stable, uniform and firm. For this reason, seeding, rather than sod, is recommended. Common practice is to sow seed in the spring and bring the court into play the following spring.

Grass courts are cool and soft, like clay and fast dry courts, but they provide fast play. Because the turf surface allows the ball to skid, it has a low, fast, unpredictable bounce, making for a challenging game. In fact, it has been said that grass lends itself to the largest variety of strokes and strategies, providing the perfect match. Grass courts blend well with any type of landscaping or surroundings. On the other hand, constructed grass courts are high in initial cost and all grass courts require constant maintenance, similar to that of a golf green. This includes brushing, rolling, lining, fertilizing, fungus control, aerification, grub and worm control along with watering, mowing and reseeding or resodding.

Sand-Filled Synthetic Turf

Since many institutions lack the staffing, the knowledge and/or the maintenance equipment to properly care for a natural grass court, sand-filled turf was developed to provide some of the look and playing characteristics of natural grass with less maintenance.

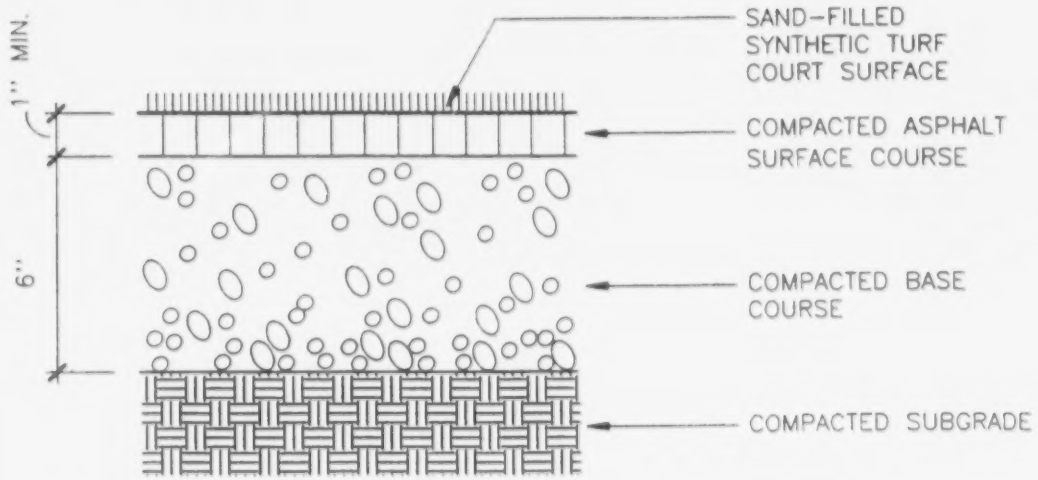
Often, sand-filled turf systems are laid over existing asphalt or concrete pavements, providing one means of reconstructing badly weathered or cracked courts. However, if a cracked pavement is to be covered with a sand-filled turf surface, the pavement must be leveled to insure planarity. Installation of a sand-filled turf surface over an uneven or cracked court will result in the cracks showing through and the turf wearing unevenly.

Sand-filled turf surfaces also are a good choice for rooftop installations or for other sites where access by heavy equipment is difficult or costly.

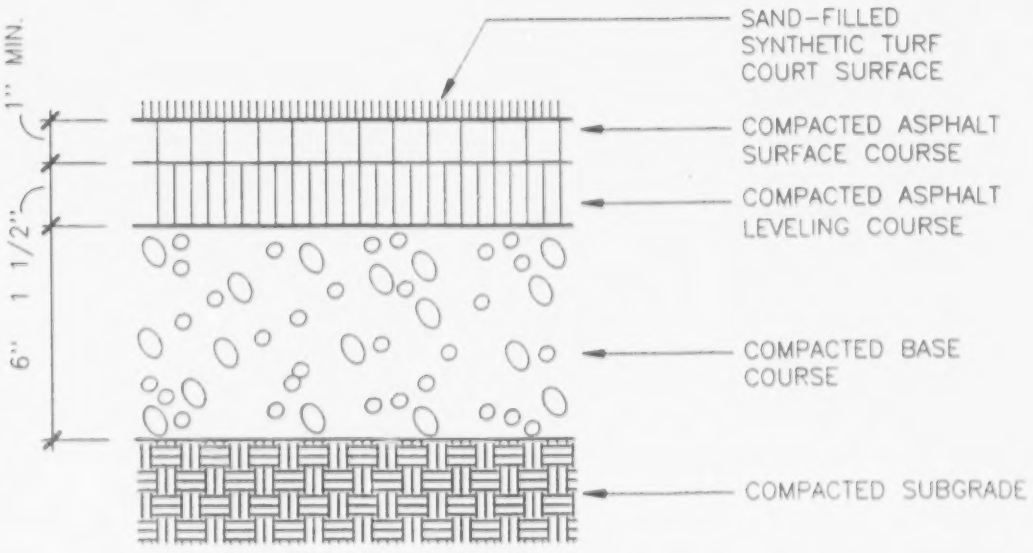
Sand-filled turf systems are constructed by installing a densely-woven polypropylene (or other durable synthetic material) carpet with a synthetic backing in 10' (3.048m) - 12' (3.658m) wide panels over an asphalt or concrete base. In some systems, the turf is manufactured with a cushion backing or installed over a cushion mat to provide greater player comfort.

Silica sand is then introduced into the fibers as fill. The sand is compacted between the pile fibers to keep the fibers standing up. This creates a soft, stable surface for play. This surface provides very little friction between itself and the player's shoes. It is basically easy to maintain, requiring only occasional brushing to maintain uniformity of the surface. Rainwater drains off quickly and easily.

NOTE:
RECOMMENDED COURT SLOPE:
MINIMUM – 0.833 %
MAXIMUM – 1%



ASPHALT COURT FOR NON FREEZE/THAW CLIMATE



ASPHALT COURT FOR FREEZE/THAW CLIMATE

TYPICAL SAND–FILLED TURF COURT SECTIONS

NOT TO SCALE

SAND – 1

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When a new sand-filled turf surface is installed, it will take a while for the sand to migrate down into the surface fibers and compact. It may be necessary to top dress the surface with sand every two weeks or so in the beginning to compensate for compaction. Also, because the sand is looser and nearer the top, it may move or shift. Regular brooming will be required to reposition the sand evenly.

Thereafter, weekly maintenance of sand-filled turf courts includes redistributing sand uniformly over the surface. Adding sand to heavy play areas is required at least annually in order to maintain a consistent playing surface and to prevent uneven wear.

Players sometimes complain that the sand-filled turf surface is so unique that it requires a considerable adjustment to their game. Also, unless the surface is well-groomed, any imbalance of sand will result in irregular ball bounce and non-uniform traction. Another disadvantage of sand-filled turf courts is that they cannot be resurfaced. Once such courts show pronounced signs of wear, the surface must be completely replaced.

Hard Courts

According to one industry poll, more than 70% of the tennis courts in the United States are hard courts — asphalt or concrete pavements, generally covered with a colored surface coating system.[3] The coating system protects the court from the elements, enhances its appearance, and determines the playing characteristics of the court. Hard courts are low maintenance, which makes them popular for institutional applications. In addition, hard courts are playable whenever there is no snow or ice on the ground, and they drain and dry quickly after rain, earning them the nickname "all weather courts."

Hard courts, both asphalt and concrete, in general, are low-maintenance structures which do not require daily care. For this reason, they are an ideal choice where an owner does not plan to supervise play, has limited time to care for the court, and/or where players will be keeping courts in use for all or most of the year in colder climates. Outdoors, rain does a natural cleaning on hard courts though regularly sweeping or cleaning a court will help avoid stains which can occur when leaves or other debris are left lying on the surface. Mildew or algae, which are sometimes a problem in warmer, more humid regions, can be removed with a mild herbicide or with a bleach and water solution or with a pressure washer. Asphalt courts are the most common type of tennis court because they provide good value for the cost and are easy to care for; however, cracking is a natural part of the weathering and aging of asphalt. Post-tensioned concrete, on the other hand, while more expensive, is especially resistant to cracking.

Generally, a hard court produces a fast game. This speed can be adjusted according to the type of surface system which is applied to the court. A smooth surface will increase ball skid and decrease the effect of spin producing a fast game, while a gritty surface will reduce skid and enhance the effect of spin, producing a slower game.

Asphalt Courts

Asphalt courts make up the majority of hard courts. Asphalt is a liquid material refined from petroleum. When liquid asphalt is mixed with graded stone aggregate, compacted and allowed to cure, it becomes asphaltic concrete, also known as asphalt or blacktop.

Liquid asphalt can be combined, mixed and delivered to a court via various processes. Asphalt courts usually are constructed using hot plant mix asphalt. Often the choice of a specific type of asphalt and stone aggregate is determined by soil or climatic conditions, by the availability of materials in the area or by the expertise of the contractor.

3 The Industry's First Comprehensive Tennis Industry Study, April 1991.

Asphalt is a flexible pavement, giving slightly with the ground's movement due to settling or to the action of water or to freeze-thaw activity. However, as asphalt weathers, it oxidizes, shrinks and hardens, making it less flexible and more subject to cracking.

Cracking due to shrinkage is the most common problem with asphalt courts and occurs in all courts with age. Some cracking, particularly hairline cracking, can be expected with normal exposure to weather and wear and with aging asphalt. These cracks will develop into larger cracks when exposed to weather or when vegetation, worms or mold enter the cracks, so they should be treated promptly. Sometimes cracks are caused by improper use of materials, improper construction or settlement in the subbase.

Asphalt courts usually are built up in several layers. First the earthen subbase is treated with herbicide, compacted and sloped according to the site plan. Often, a gravel subbase is added next to improve drainage and to raise the subbase 4" (102mm) - 6" (152mm) above the surrounding ground so that the finished court surface is 10" (254cm) - 12" (305mm) above the surrounding ground. The court is then sloped in a true plane a minimum of .833% (1:120) to a maximum of 1% (1:100). Side to side is the preferred direction of slope; however, it can also be end to end or corner to corner if side to side cannot be achieved.

Next, the court pavement is constructed in various courses. In northern climates, these include a base course of crushed stone or gravel, reprocessed asphalt pavement (RAP) or reprocessed concrete, compacted to a minimum of 4" (102mm). Next, a leveling course of asphalt is installed and compacted to a depth of not less than 1 1/2" (38mm). In southern climates, often only a 4" (102mm) to 6" (152mm) base course is used.

Finally, a surface course of asphalt is spread and compacted to a uniform density and thickness of not less than 1" (25mm). The finished surface course must not vary more than 1/8" (3mm) in 10' (3.048m) from one true plane, calling for careful installation and compaction.

Once construction of the asphalt pavement is completed, the asphalt should be thoroughly cured. Color coatings won't bond effectively or evenly to an inadequately cured surface. Curing may take from ten days to one month, depending upon site conditions and weather. A curing period of 14 - 21 days is strongly recommended, the longer the better. Ultraviolet light, from the sun, and water both aid in pulling light oils from the asphalt during the curing process. It should be noted that, unlike coatings and sealers used in other applications, the surfacing systems used with tennis courts breathe; some curing and hardening will continue after surfacing.

Concrete Courts

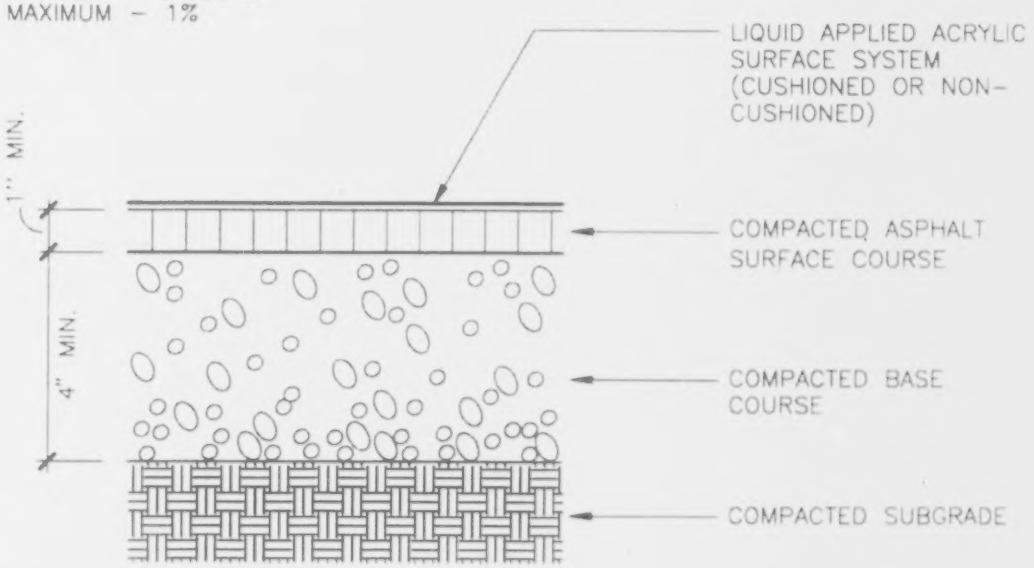
Properly installed concrete courts are extremely durable with low maintenance costs after initial construction, though initial cost may be somewhat higher than that of asphalt courts. If problems occur, concrete courts are more difficult to repair than asphalt courts.

Concrete is the product of mixing crushed stone or gravel and sand with Portland cement. It is an extremely rigid pavement. Because of their durability, concrete courts are useful in areas of poor soil or extreme freeze-thaw cycles. They are resistant to settling and heaving; however, some cracking can be expected.

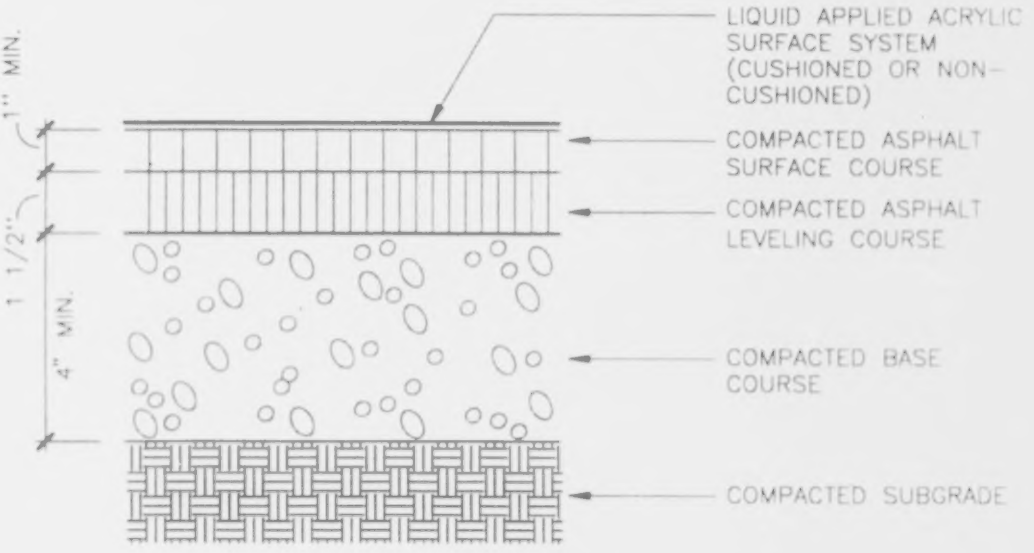
There are two kinds of concrete courts — reinforced concrete and post-tensioned concrete.

A reinforced concrete court generally consists of two half-court concrete slabs 4" (102mm) to 6" (152mm) thick separated by an expansion joint, 3/4" (19mm) and filled with elastomeric material, under the net. Expansion joints also are placed between adjacent courts. The location of expansion joints is critical as they can be a tripping hazard.

NOTE:
RECOMMENDED COURT SLOPE:
MINIMUM – 0.833 %
MAXIMUM – 1%



ASPHALT COURT FOR NON FREEZE/THAW CLIMATE



ASPHALT COURT FOR FREEZE/THAW CLIMATE

TYPICAL ASPHALT COURT SECTIONS

NOT TO SCALE

ASPH – 1

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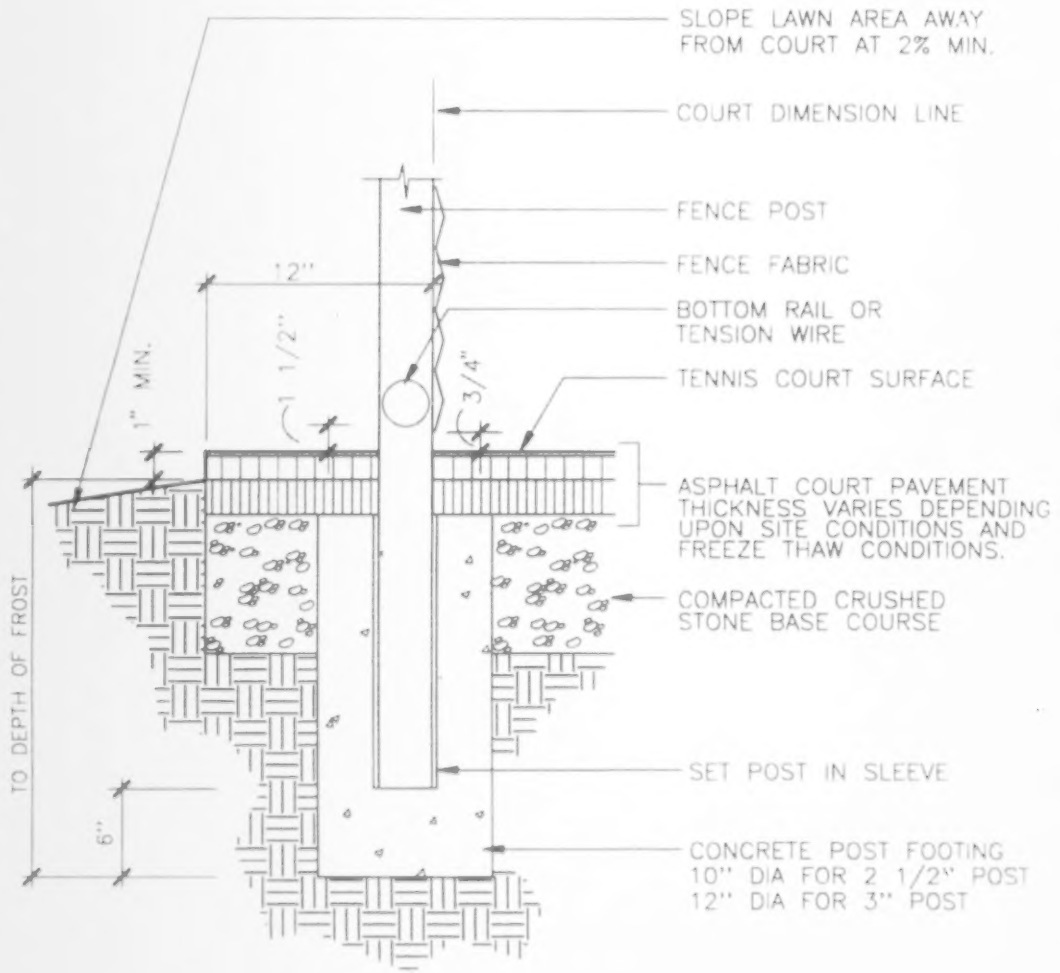

SECTION EXTENDED APRON AT ASPHALT COURT EDGE

NOT TO SCALE

EDGE – 2

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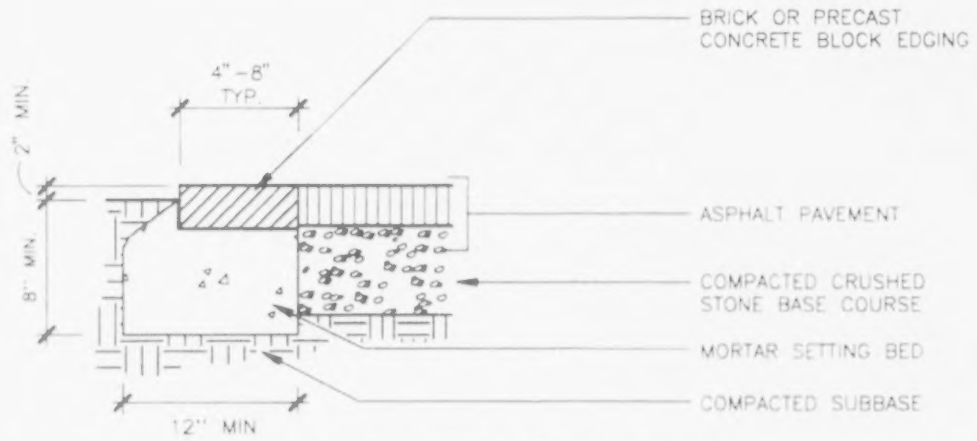
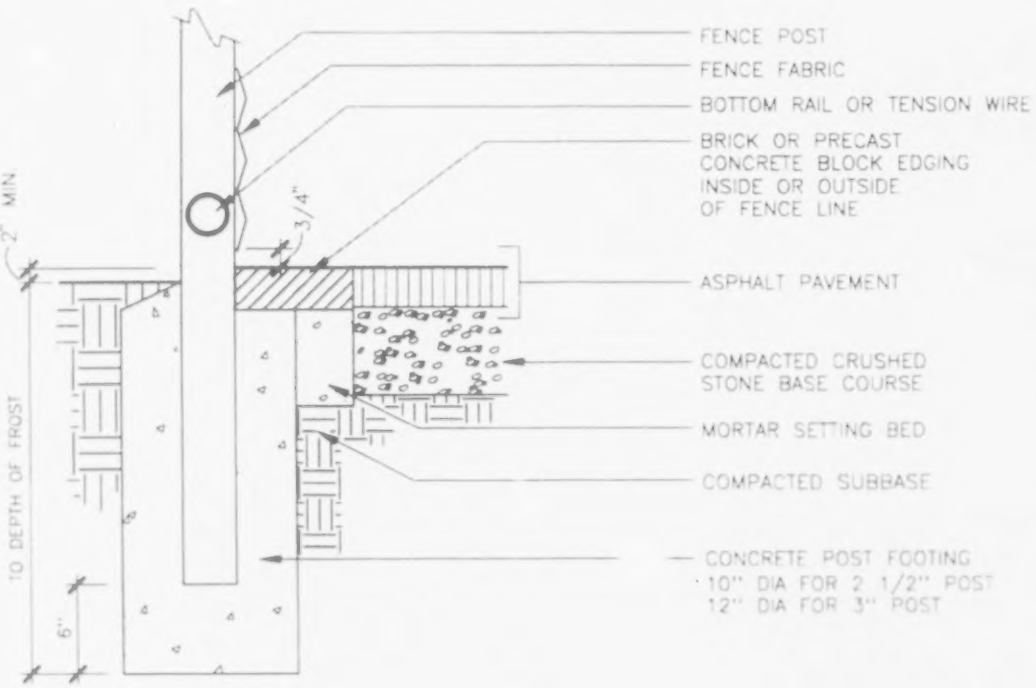


SECTION ASPHALT COURT EDGING



SECTION ASPHALT COURT EDGING AT FENCE POST

TYPICAL ASPHALT COURT EDGING WITH BRICK OR CONCRETE BLOCK

NOT TO SCALE

EDGE – 1

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cushion materials must be thoroughly dried and cured to prevent future surface peeling. If shrinkage cracks appear, they should be addressed prior to application of subsequent coats of surfacing material. The completed texture course should be free from ridges or squeegee marks and should be uniform in texture.

This hard court has two problems: surface bubbling (caused by moisture caught between the pavement and the surfacing material) and birdbaths (depressions in the court surface that retain water after a rain).

The color finish coats are applied next. Two to three coats of color coating, depending upon the coating system used, are applied with a squeegee. There are several theories regarding the application of color coatings. Some manufacturers and contractors recommend that coats of color be applied in alternate directions. Others believe that all coats should be applied in the lengthwise direction since the flow of play in tennis is almost entirely lengthwise. Still others believe that color coatings should be applied in a crosswise direction since the shorter crosswise pass may result in more uniform application and minimize the appearance of "brush strokes." In any case, the coating must be applied smoothly and to a uniform thickness over the entire court surface. This requires an experienced applicator and careful attention to the application.

Owners often have difficulty comparing color coating systems. The goal is to achieve a durable system with uniform, lasting color. Depending upon the manufacturer, color coatings consist of some or all of the following components: binder (styrene butadiene, vinyl acetate, latex, acrylic or a combination of these materials), color pigments, fillers, extenders, additives and preservatives. There are various grades of coatings. Better quality coatings will generally have an acrylic binder, a high proportion of solids, fade resistance, color stability, good coverage and mildew and fungus resistance. Some systems use a color filler coat. Others do not. Some use fine sand aggregate, resulting in a thinner coat, while others use somewhat coarser sand aggregate, resulting in a thicker coat. One way of comparing systems is to compare how many gallons of undiluted color are applied with the system.

Some or all of the coats should contain silica sand, depending on the speed of play desired. The amount of sand incorporated in color coatings and the particle size of the sand determine the amount of texture the finished surface will have. The amount of texture, in turn, determines the speed of the surface, the effect of spin and similar playing characteristics. Coatings can be purchased with or without sand. Since specifying the grade and amount of sand is highly technical, many contractors rely on experienced manufacturers to premix sand with the coating material.

With cushion surface systems, which contain rubber granules, additional coats may be applied to achieve the desired cushion. Each coat must dry thoroughly before a succeeding coat is applied. One day drying time is average, though in ideal conditions up to three coats may be applied in a day, depending on the manufacturer's specifications and recommendations. Most acrylic surfaces take 72 hours to dry completely and reach full strength. It is recommended, therefore, that playing on or cleaning a new surface be avoided for that period of time.

Once coated and thoroughly dried, the court is lined. Using a regulation tennis court diagram, lines are marked. All measurements on a tennis court diagram are to the outside of each line and no measurement should vary more than .25" (6mm) from the exact measurement. The standard color of tennis court markings is white.

According to the ITF Rules of Tennis, all lines on the court should be continuous. However, an option in line painting, which is common in some areas of the U.S., is to leave a space of 1 1/2" (38mm) - 2" (51mm) open in the singles sideline immediately behind the service line. This gap facilities line calling on the serve without hampering line calling during play.

Using a taping machine and masking tape, the lines are taped. Lines are then spray painted or hand painted (hand painting is recommended) with one or two coats of latex or acrylic line paint recommended by the manufacturer of the color coating system. If the colored surface coatings contain sand, the line paint should contain the same amount and type of sand for consistency of ball bounce and to minimize the likelihood of player injury from slipping on the line. Traffic, oil, alkyd or solvent vehicle paint is unsuitable for tennis court lines and should not be used.

Occasionally owners express concern over unexpected conditions observed in new courts. Many of these conditions are normal. For example:

After the first few rains, soap bubbles will appear on the surface of a newly coated court. Detergents are added to coating materials to insure that the colored pigments are dispersed throughout the coating material. While soap bubbles probably will not be visible on an indoor court, the court may be slippery, particularly if there is high humidity or condensation in the building or if players have wet shoes when they walk on the court. Since there is no rain to wash the detergent off the surface of an indoor court, the slippery condition may last for a week or two. Players should exercise particular caution against slipping when using a newly constructed or newly resurfaced court.

Newly applied color coatings may have slight variations in color from one area to another but should appear to have a uniform color and texture when viewed from 25' (7.620m) away.

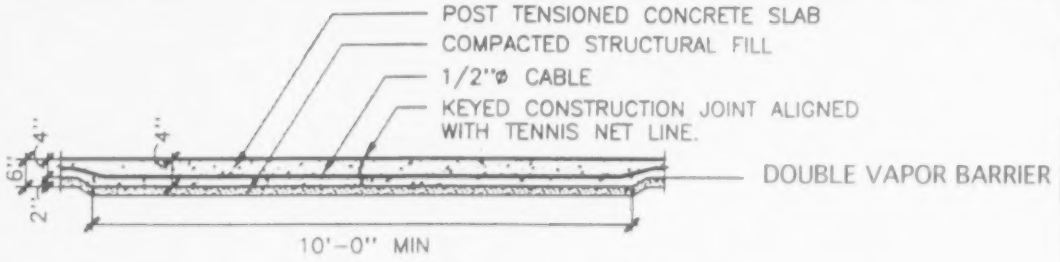
Owners, anxious to try out a new surface, may use the court before it is fully cured. When a player stops quickly or twists his shoe, the color coating may become detached from the asphalt bound undercoats. This is particularly true if the player has tennis shoes with deeply grooved patterns on the soles. Players should exercise great care in playing on a newly surfaced court.

Tennis shoes will leave white scuff marks on a newly surfaced court. The number and severity of sneaker marks will decrease over time and owners should not be concerned by them. Black-soled shoes, however, make particularly unsightly marks on tennis court surfaces. Black-soled shoes should not be permitted on any tennis court.

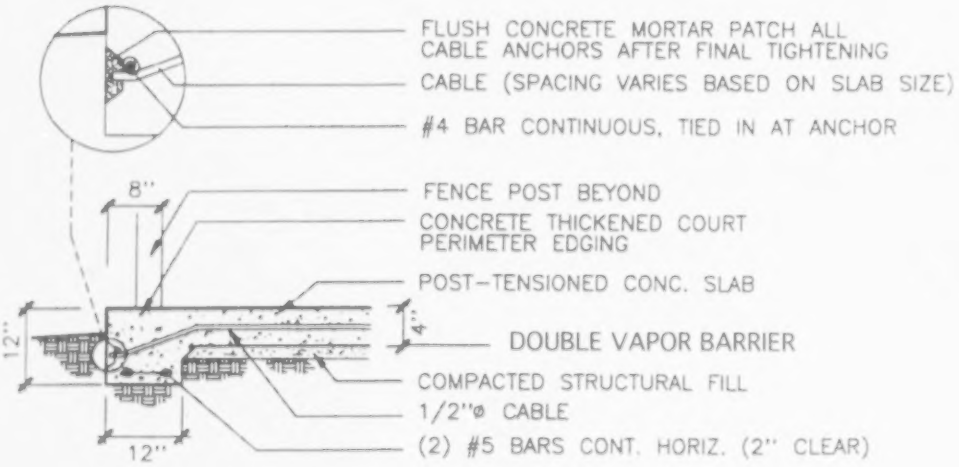
Excessive ball wear and ball fuzz adhering to the court may be evident on a new court. This happens because of the sand used to regulate the speed and play of the court. Like a new sheet of sandpaper, a new tennis court is far more abrasive than a used one.

New concrete courts may show some "ghosting." When the concrete used in construction contains lime, the lime may migrate up through the coating, leaving a white residue. The migration of lime can be minimized by proper preparation of the concrete pavement before color coating.

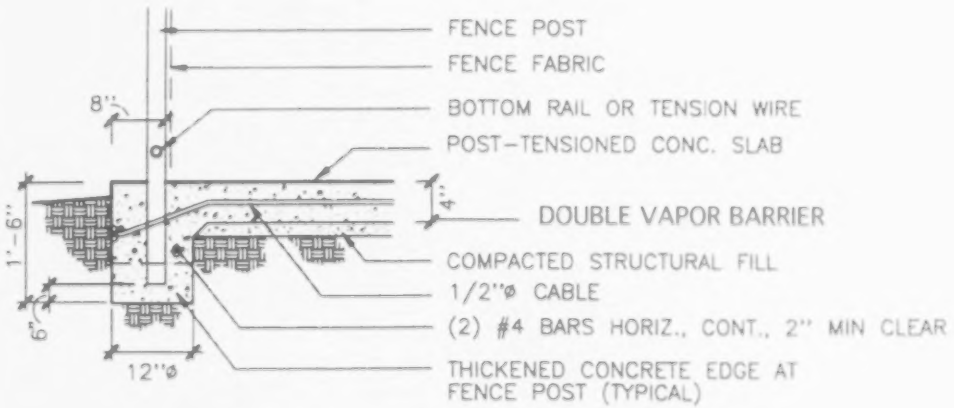
Due to the nature of the material, concrete is difficult to coat. Even a well-constructed, properly coated concrete court may show small areas of peeling. These areas should be touched-up immediately to prevent further damage to the court surface.



SECTION KEY JOINT AT NET LINE



SECTION THICKENED COURT EDGE



SECTION THICKENED COURT EDGE AT FENCE POST

TYPICAL SECTIONS POST-TENSIONED CONCRETE COURT PAVEMENT

NOT TO SCALE

PTCONC

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Color Coating Systems for Asphalt and Concrete Courts

The purpose of coating systems is to create a uniform surface. By filling small voids and depressions, coating systems provide a level of uniformity which cannot be achieved in construction with asphalt and concrete. In addition, coating systems help to provide a surface which drains properly and one which has the desired playing characteristics. Also, color coatings help the pavement to resist weathering, reduce surface temperature to promote player comfort, cut glare to enhance play and provide color, contrast and other aesthetic values.

Once cured, the asphalt or concrete pavement is prepared for application of a color surface system. These surface systems vary somewhat from manufacturer to manufacturer; each manufacturer provides instructions for patching, filler coats, mixing and application of its surfacing materials.

To properly apply a surfacing, first, clean the pavement thoroughly. All foreign materials must be removed. Depending upon conditions, blowing debris, hosing or scraping loose material is often sufficient. At other times, particularly when landscaping or fencing work has left mud and debris on the court, power washing may be required.

Once the pavement for a hard court has been allowed to cure, the acrylic surface is applied with a squeegee. PHOTO COURTESY OF HUBBARD R. JONES & SON, INC.

Next, the pavement is flooded with water and allowed to drain to check for planarity. Low areas, or "birdbaths," are defined as any areas where standing water more than 1/16" (2mm) deep (commonly measured using a nickel) remains after drainage of the area has ceased or after one hour at 70 degrees Fahrenheit (21 degrees Celsius) or above in sunlight. Before correcting birdbaths, however, it is important to determine their cause. Are the birdbaths actually low areas, or are they created by adjoining high areas? A simple string test can provide an answer. High areas should be leveled by scraping or grinding. Low areas in the surface should be patched and leveled according to the recommendations of the manufacturer of the color surface prior to proceeding with coating.

Once the pavement has been properly prepared, the next step is the application of filler or texture materials. No coating work, including the filler course, should be performed when rain is imminent or when the temperature is below 55 degrees Fahrenheit (13 degrees Celsius). Special care must be taken in the application of the filler course if the pavement is rough or if it has an excess number of voids in the surface. One or more filler coats, consisting of asphalt emulsion or acrylic-based binders mixed with sand aggregate, are applied to remove minor surface irregularities and to fill the voids in the asphalt surface course. Cushion coats or texture coats are then applied.

Color surfacing systems are applied with a squeegee. An experienced squeegee operator will note any previously undetected variations in the pavement which must be repaired prior to color coating. Following application, filler or

The concrete slabs are reinforced by steel mesh or reinforcing steel (rebar). Specially developed reinforcing fiber is sometimes added to reduce temperature cracking. The slab is built on a subbase of graded aggregate at least 6" (152mm) thick, with a vapor barrier between the subbase and the concrete slab.

Post-tensioned concrete courts are reinforced by means of sheathed steel cables within the concrete slab. Cables are installed in a grid and permanently fastened at one end. After the concrete has begun to set and has reached sufficient strength, the steel cables are tightened and held permanently under stress. This stressing process generates tremendous pressure and should, therefore, only be attempted by a contractor experienced in this type of construction.

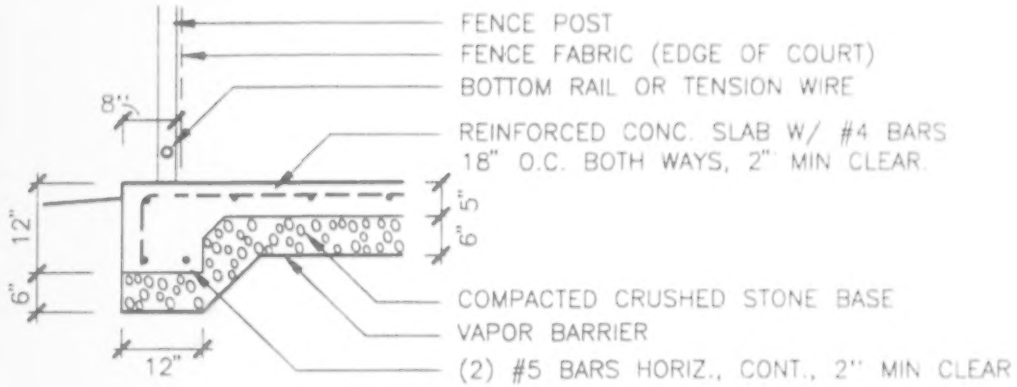
The construction of a post-tensioned concrete court. Note the steel cables in the foreground, and the expansion joint in the center. A vapor barrier has been installed between the subbase and the concrete slab. PHOTO COURTESY OF CAPE & ISLAND TENNIS & TRACK

A single post-tensioned concrete court will not require an expansion joint. Multiple court banks, however, should have an expansion joint between every two courts. Because expansion joints may be a tripping hazard for players, the fact that fewer are required with a post-tensioned concrete court is considered an advantage.

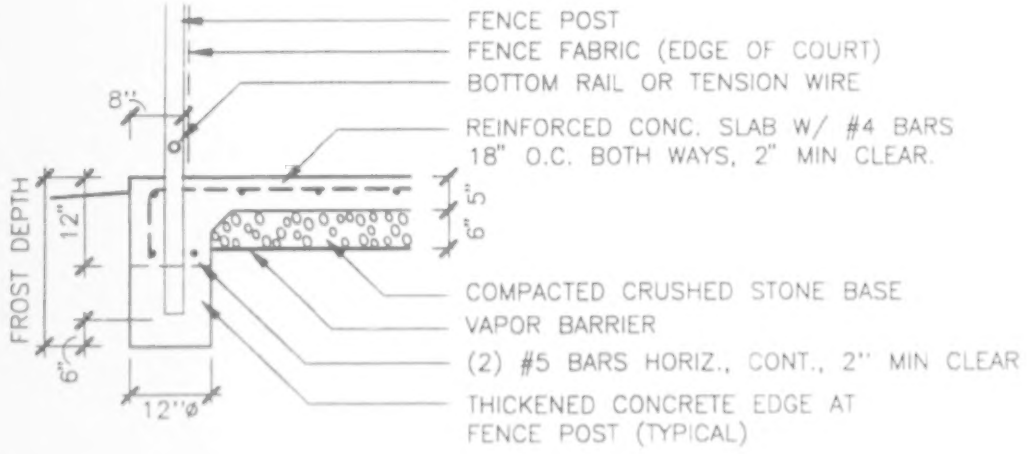
Because the concrete in post-tensioned courts is constantly under pressure, the slab is extremely rigid. Even a battery of courts can be constructed as a single slab. If settlement takes place under the slab, the internal strength of the post-tensioned slab keeps cracking to a minimum. If small cracks appear, the tensioning cables hold them together and they will not increase in size.

Both reinforced and post-tensioned concrete slabs must be cured for 28 days before they are surfaced with a coating system. To cure, concrete slabs must be kept continuously moist for approximately seven days (curing time varies according to the surfacing system to be applied; consult the manufacturer) by a covering of polyethylene film, burlap or curing paper or by sprinkling or ponding, followed by additional curing of up to 21 days. Ordinary petroleum-based curing compounds should not be used and, generally, curing compounds are not used in tennis court installations. They may affect the bonding of the surfacing system to the concrete.

Once curing is completed, concrete must be prepared for the application of a surface coating since naturally occurring salts in concrete prevent acrylic surface systems from adequately bonding to the pavement. Generally, the concrete pavement is acid etched to clean it and to neutralize the salts in the concrete. Next, the pavement is primed with a primer approved by the manufacturer of the coating system if a court surfacing system is to be applied directly to the concrete. Frequently a 1" (25mm) asphalt surface coat is applied over the concrete pavement as a way of avoiding potential surface bonding problems.



SECTION THICKENED COURT EDGE



SECTION COURT EDGE AT FENCE POST

TYPICAL SECTIONS REINFORCED CONCRETE COURT PAVEMENT

NOT TO SCALE

CONC – 1

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In the course of normal use and exposure, hard tennis courts should be recoated every three to seven years, depending on the number of applications in the surface system used, the quality of coating applied, the quality of application, the climate, the amount of use and the frequency and quality of maintenance. The single most important factor in prolonging the useful life of tennis surfacing systems is keeping them clean.

Cushioned Surfaces

Sometimes a resilient layer of cushioning material is applied over asphalt or concrete prior to color coating. Alternatively, some coating materials contain rubber and produce a cushioned effect. While the cushioned surface has some give, such courts are called "cushioned" to separate them from clay and fast dry courts which are called "soft" courts.

Cushioned courts usually have excellent playing characteristics including good traction and a true, uniform, slow to medium-fast bounce. They also provide an all-weather surface for year round play and relatively low maintenance. These attributes make them popular with players, but, depending on the amount of cushioning provided, such courts are considerably more expensive than traditional hard courts.

Materials used to create the cushion include rubber granules, rubber particles, elastomers, or prefabricated polyester membranes. Cushioning materials are held in place by asphalt, acrylic, latex or urethane binders. Cushioning may be prefabricated, fabricated on site, sprayed or squeegeed over a concrete or asphalt base. Poured-in-place systems are formed in the field by mixing a polyurethane binder with rubber granules and applying the mixture to the substrate in thicknesses varying from 1/4" (6mm) to 1/2" (13mm) to form a cushioned course.

Because of the growing popularity of cushioned courts, a great deal of research and development is ongoing in this field. If an owner is considering a cushioned court, it is imperative that a professional tennis court designer or experienced tennis court contractor be consulted for the latest information on available options.

Upkeep and maintenance of cushioned courts are the same as that of hard courts —sweeping or hosing the surface to remove dust, dirt and debris. Resurfacing time varies but averages every three to seven years. The cushion course can be penetrated or dented by high heels, street shoes, golf shoes, metal racquets, play equipment such as skateboards, in-line skates or hockey sticks, or heavy loads. Inappropriate footgear or equipment should not be permitted on a cushioned court surface.

Cushioned courts share many of the other advantages of hard courts, including a non-glare surface which improves player comfort; sure footing and no skidding, which is important to player safety; and rapid drying after a rain which enhances useability.

Modular Surfacing Systems

Modular tennis courts are those whose surfaces are made up of interlocking tiles approximately 1' (305mm) square and usually composed of polypropylene and rubber. These systems are put into place over a base of asphalt or concrete.

Modular systems are often used by health clubs, hotels and other facilities which offer rooftop tennis courts, and have also become an alternative to completely reconstructing a deteriorating court. The tiles are durable and can be easily swept clean or rinsed with a hose and/or scrub brush. Damaged tiles can be pried up and replaced with a minimum of trouble. While freeze-thaw cycles may affect the pavement base on which a modular court is laid, the tiles are basically weatherproof. These courts dry quickly after rain, but they can be slippery while still damp.

These courts are relatively expensive if, in addition to the modular surface itself, a new pavement or extensive repairs to create a level base must be provided. Without a level base, the tiles will bridge low areas and create dead spots in the court. If the court is built on an existing surface which is structurally sound and level, cost will be significantly decreased.

As the modular surface deteriorates, individual tiles may be replaced. The price of repairing a court will vary depending upon the number of tiles which need to be replaced at one time.

Sheet or Roll Goods

Sheet or roll goods surfacing systems consist of a multi-layer membrane installed temporarily or permanently over an asphalt or concrete pavement base. The membrane is attached to the pavement at the edges and is otherwise free floating over the court.

To construct such a court, first a smooth pavement must be provided. It is important that small voids, depressions and cracks be repaired and leveled prior to installation of the sheet goods, since the membrane system will bridge a low area or crack, creating a dead spot in the court. Next, the membrane system is laid out over the court in strips and seamed together to form a single court membrane. Finally, in a permanent installation, a color surfacing system is applied over the membrane.

Membrane systems are used over new asphalt or concrete pavements to provide cushion or over cracked or worn pavements as resurfacing. In addition, they are extremely popular in temporary installations for tournaments and exhibitions. These can be laid in 12' (3.657m) wide strips and held in place by their own weight, or by double-face tape at the seams. Special equipment is available to roll and store the surface. Many indoor tournaments are played on this type of court since such a court can be installed and removed in a short period of time. Care must be taken in storing, moving and installing the system to prevent damage to the edges of the material. In addition, if the seaming tape does not provide a secure anchorage, the seams may cause bad bounces or may constitute a tripping hazard.

Other Surfaces in Less Common Use in the U.S.

Asphalt Penetration Macadam

In the United States, almost all asphalt courts are constructed of hot plant mix asphalt. Asphalt penetration macadam is, however, the most common type of asphalt court in England and throughout Europe.

These courts are constructed on a suitable base (usually of local materials such as stone, gravel, slag or shell.) Layers of increasingly fine aggregates are then spread, compacted and sprayed with liquid asphaltic binder that penetrates and binds the aggregate. Between layers, the surface is broomed to improve its plane and texture. The surface is finished by the application of conventional surface consisting of a mineral-filled asphaltic slurry or an acrylic tennis court coating. As an alternative, green ceramic granules are sometimes applied to create a coarse, textured playing surface.

Synthetic Granular Surfaces

Synthetic granular surface systems are becoming available in a variety of different combinations of materials. Two of the most common are:

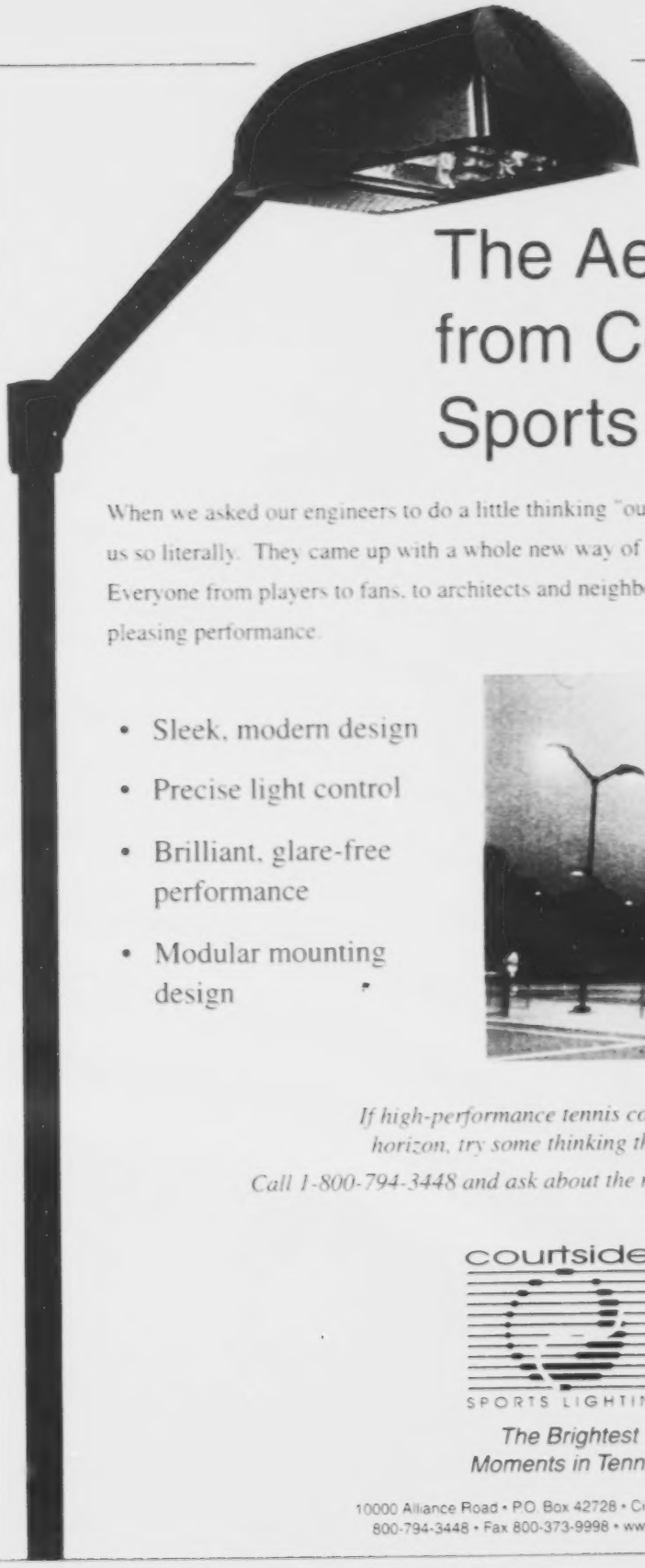
1. Polyurethane bound rubber granule cushion course with a loose colored synthetic rubber granule surface to provide a clay-like appearance and playing characteristics. These courts are available in red, green or tan.

2. A fiber base matting adhered to a substrate and covered with colored synthetic rubber granules. Approximately 70% of the rubber granules filter into the matting, supporting the fibers, providing cushion and preventing distortion. Additional loose granules are then spread on the surface to yield a clay-like appearance and playing characteristics. These courts are available in red and green.

Synthetic granular surfaces provide a great deal of player comfort. These surfaces can be tuned by adding or removing granules. Both systems require brushing to maintain a uniform distribution of the granules over the playing surface. Lines can be brushed or left covered with granules to show a footprint of the ball when it hits. The polyurethane bound system can be used either indoors or outdoors if a porous base is provided. The fiber mat system only can be used indoors.

Textile Systems

Textile materials used as tennis surfaces resemble indoor/outdoor carpeting. They are normally a higher quality, however, manufactured to more exacting specifications. Textile surfaces are fast and provide a true bounce as well as excellent acoustical absorption. Their sound absorption is a significant benefit when using them indoors. These surfaces require minimal maintenance beyond an occasional vacuuming to remove ball fuzz. A textile surface can be installed permanently by adhering it to the substrate or it may be used as a temporary or portable surface. A down side of a textile surface is that its playing characteristics are determined at manufacture and cannot be altered. Also, only minor repairs are possible. When a court shows wear, it cannot be resurfaced but must be removed and replaced.



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Chapter V

Accessories and Amenities

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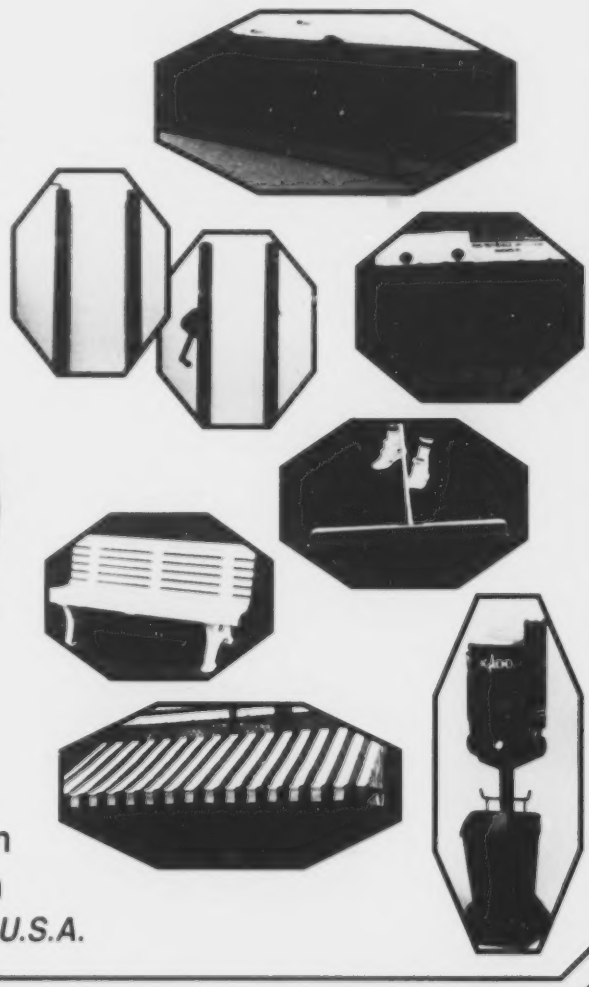

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Accessories and Amenities

Court owners and facility managers have a wide range of court and player amenities and accessories to choose from. What is right for a residential court may not be right for a court at a resort. What is right for a public court may not be right for a private club. The right accessories and amenities depend on budget, intended use, player preference, climate and conditions of installation, and on many other factors. Time spent analyzing what is available and the relative advantages and disadvantages of the various options may well pay substantial dividends in long term cost savings and player satisfaction.

Even a well-designed and well-constructed tennis facility may still lack the features that make it a pleasure for players to use. This chapter will describe the accessories that are necessary or desirable for court use, as well as some of the amenities that add immeasurably to the quality of a tennis facility. Maintenance equipment is discussed in Chapter VII.

Tennis Court Accessories

Tennis court accessories are those items, not part of the actual court construction, which are necessary or highly desirable. They include net posts and nets, lighting, fencing, windscreens and divider curtains.

Net Posts

According to *The Rules of Tennis*, net posts may be no more than 6" (152mm) in diameter or 6" (152mm) square and not higher than 1" (25mm) above the net cable. Circular posts should be not less than 2 7/8" (73mm) in diameter and square posts should be not less than 3" (76mm) square.

Net posts are most commonly made of steel. A few manufacturers produce net posts made of aluminum to resist rusting. Wooden net posts and brass net posts also are available. Regardless of the material from which they are constructed, it is important that net posts be sufficiently strong to allow safe tensioning of the net. A minimum yield strength of 1,100 lbs. (499kg) and a minimum tensile strength of 1,500 lbs. (680kg) are recommended.

Posts come in black and green; post color is usually coordinated with surface color, fencing, lighting, and windscreens. Green has been the most popular color choice, but black is also very popular.

Posts are equipped with screw-type, worm-gear or rachet-type internal or external winding mechanisms to tighten the net. Some older courts are still equipped with lever-action net posts. These posts are considered a danger to players and should be replaced. To prevent a potential hazard, all net posts with external winding mechanisms should be limited in the amount of force applied to the net post, not to exceed one-half of the post's yield strength. In addition, net posts should have handles which can be removed or secured or which are set parallel to the post. Safety over-caps provide additional protection against injury. Internal wind posts cost more than external wind posts, but are both safer and more attractive.

Net posts may be permanently installed or they may be set in sleeves, making them removable and allowing use of the court for multiple purposes. Net posts set in sleeves also make resurfacing and maintenance easier. Setting the posts in sleeves is more expensive initially, but in addition to allowing multiple uses for the court, such installation prevents the future need to dig up the post footing in order to replace bent, rusted or broken net posts. Sleeves should be large enough to accept the post to be installed and should be round or square, depending upon the type of post that will be used. They should be positioned in the center of the footing. Extending the bottom of the footing slightly in the direction of the opposite post may increase its resistance to excessive stress caused by over tensioning the net.

Net post footings should be round at the top, not less than 18" (457mm) in diameter tapering out to a square bottom not less than 30" (762mm) at the bottom. Footings should be 6" (152 mm) deeper than the local frost depth, but not less than 40" (1.016mm) deep. The appropriate depth depends on the particular soil conditions and the amount of freeze-thaw activity at the site. The ground in which footings are set should be firm and unyielding.

Footings should be designed and poured and the posts set so as not to cause cracking or other damage to the finished court surface. Round post footings are recommended on asphalt courts, especially when posts are set after the top course of asphalt has been installed. The corners on square footings in asphalt create stress points from which cracks often begin. The preferred method is to set posts or sleeves prior to any paving or between asphalt courses to assure a continuous court surface. Precautions must be taken to prevent asphalt from spilling into sleeves. Sleeve caps or rags can be placed in sleeves for this purpose. On concrete courts, footings should be poured integrally with the slab or they should be isolated from the slab with a continuous expansion joint.

Net posts are set 42' (12.802m) apart for a doubles court. The measurement should be made from the center of one post to the center of the other. For tournament use, it is recommended that a second set of net post sleeves be supplied 33' (10.058m) (center to center) apart for singles play and that a singles net be available. When singles posts and net are not available, in order to conform with the rules of tennis for singles play, the net must be supported at the required height of 3' 6" (1.067m) by singles sticks set 3' (914mm) outside the singles sideline. It is recommended that marks be painted on a hard court to indicate singles stick locations. A piece of line tape may be used for this purpose on a soft court. Singles sticks may be not more than 3" (76mm) square or 3" (76mm) in diameter. Singles sticks made of 1" (25mm) round or square wood stock are commonly used for this purpose.

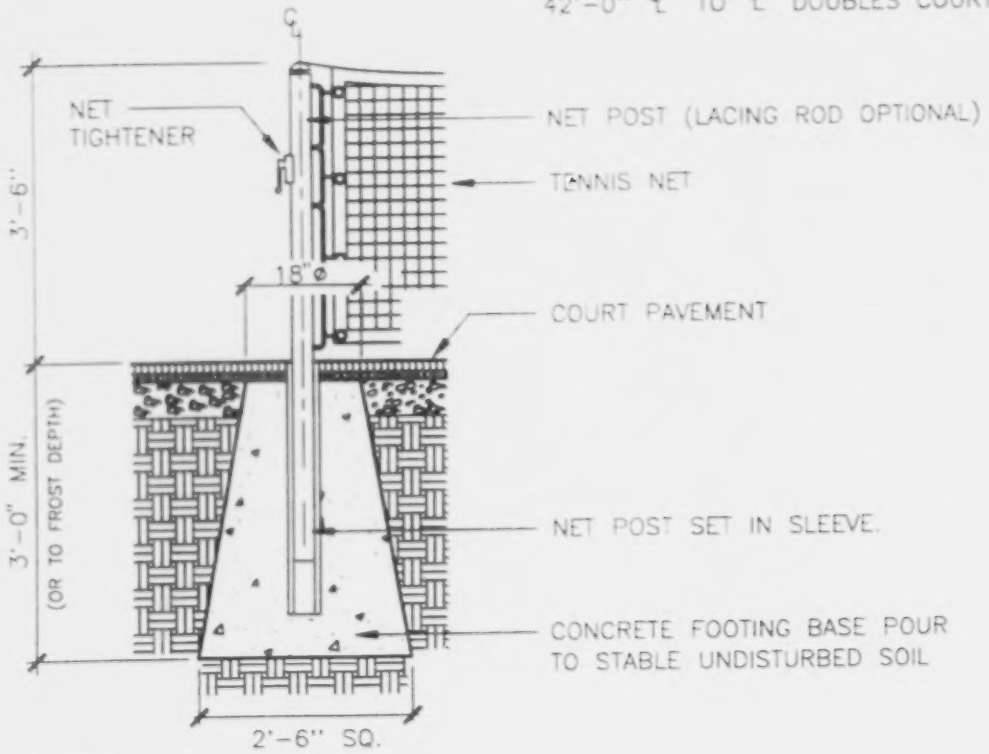
Nets

A regulation doubles tennis net is 42' (12.802m) long and 3' 3" (991mm) high. A regulation singles net is the same height, but is only 33' (10.058m) long. Since according to the rules of tennis, net posts are set 42' (12.802m) apart for doubles and 33' (10.058m) apart for singles, measured from center to center, this creates an obvious problem — how to install a 42' (12.802m) or 33' (10.058m) net, pulled tautly with tension bars and cording, on the posts. To solve this problem, many net manufacturers actually offer nets slightly shorter than the regulation dimension (i.e., 41' 9" (12.725m) for a doubles net).

NET POST LOCATIONS:

33'-0" ℄ TO ℄ SINGLES COURT.

42'-0" ℄ TO ℄ DOUBLES COURT.



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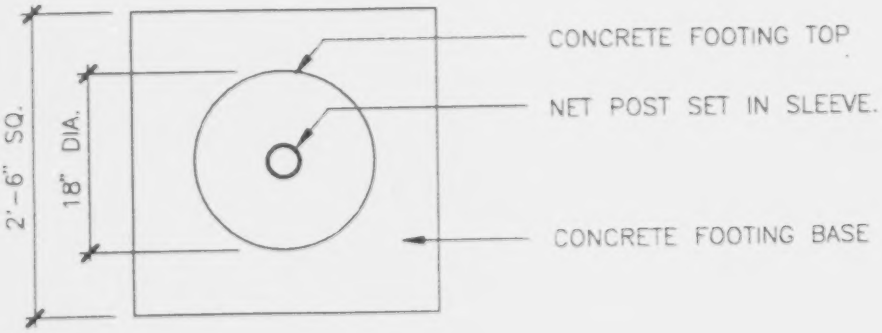

PLAN

TENNIS NET POST FOOTING

NOT TO SCALE

NETPOST

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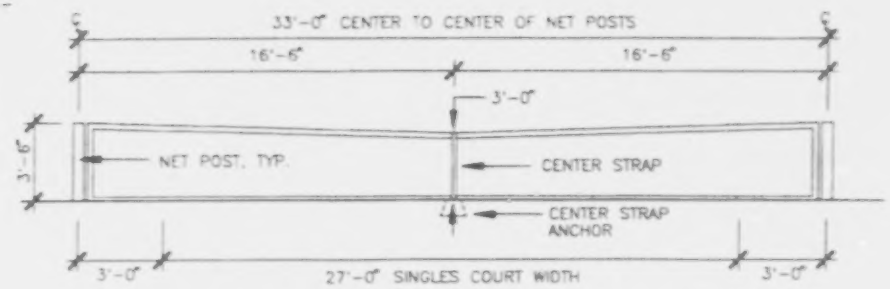
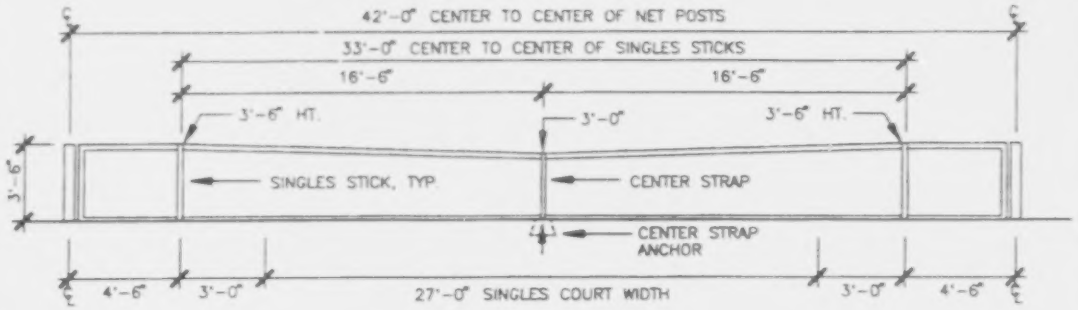
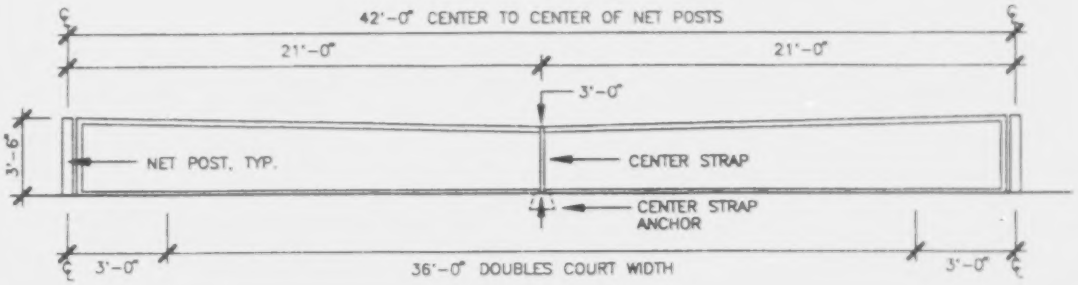
NOTE:
THE NET SHOULD BE INSTALLED WITH A RECOMMENDED TENSION OF 500 TO 550 LBS.



SINGLES NET



DOUBLES NET W/SINGLES STICKS



DOUBLES NET

TYPICAL TENNIS NET ELEVATONS

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Both singles and doubles nets are made of 1 3/4" (45mm) square mesh netting. The tensile strength of the twine used in nets ranges from 185 - 310 lbs. (84 - 141kg), though a tensile strength of at least 275 lbs. (122kg) is recommended. Traditional nets are black.

Modern tennis nets are made of synthetic materials including polyethylene, polyester and nylon. Polyethylene is most common; it provides good resistance to fading due to ultraviolet radiation and to other forms of weathering. The net cording may be twisted or braided. Braiding, though more expensive, is becoming more common because it is stronger and because it provides some shock resistance. Since braided cording absorbs energy, balls which hit the net are likely to drop down close to the net rather than rebounding off it.

Metal nets also are available. They are made from 1 3/4" (45mm) aluminum-coated or galvanized steel mesh or 11 gauge 1 1/2" (38mm) chain link. They are heavy and only slightly flexible, making them uncomfortable or possibly hazardous to players who run into them. Also, the ball rebounds farther off such nets.

The traditional tennis net has a white headband, made of heavy duty mildew resistant material, commonly polyester, vinyl coated nylon or canvas. Vinyl headbands are smooth, shiny and dirt resistant. However, the ball skids off them, so some players prefer uncoated polyester or canvas headbands. Nets with woven headbands (woven polyester or canvas) are more suited for hard courts than soft courts, where some of the fine surface material may stick in the woven headband. Better quality net headbands contain at least two layers of fabric. Four rows of lock stitching are recommended to hold the layers together and to form a sleeve for the cable.

When the original headband wears through, replacement headbands are available in both canvas and vinyl. These replacement headbands are simply folded over the top of the net and laced with twine.

Inside the headband is a steel cable for hanging the net. Sometimes the cable is coated with vinyl to minimize wear on the headband. A cable breaking strength of not less than 2600 lbs. (1179kg) is recommended, though cable breaking strengths run from 1900 lbs. (862kg) to 3900 lbs. (1769kg). While in general, a stronger cable is better, buyers should exercise some caution. Too strong a cable, pulled too tight, will bend the net posts or pull them out of their footings. Almost all net cables have 2 1/2" (64mm) - 3" (76mm) loops at both ends. When installing the net, one of these loops may have to be removed depending on the type of post winding system used. Vinyl coating on the cable, if any, should be removed in the area of attachment to the winding mechanism. Cables should be loosened or the net lowered at the end of each day to save wear on the cable, net posts, winding mechanisms and foundations. Replacement cables are available. Top quality nets include a thin twine to which a replacement cable can be attached and pulled through the tunnel in the binding.

Side bindings are generally fabricated from synthetic material in black or another color to match the net. Five nickel or brass grommets are evenly placed in the side binding to accommodate the lacing tapes. These grommets are used to stretch the net by attaching it to the lacing bars on the post or to the post itself. In addition, some nets may include a sleeve to accommodate dowels which help to hold the net taut and to give a neater appearance. These dowels should be 3/8" (9.6mm) to 5/8" (16mm) round, depending on the material, and a maximum of 40" (1.016m) long. They may be made of wood, metal or fiberglass.

Bottom bindings often are made from the same material as the side binding. In the case of bottom bindings, however, abrasion resistance is particularly important.

Net quality varies widely. Expected net life and, therefore, warranties vary as well. The amount of money to be spent on a net and the desirable features of a net depend upon its planned use. For a residential or club court where players understand proper net tensioning, a high quality net may mean an extra year or two of life. For use in areas

where abuse and vandalism may be expected, a budget or metal net may be advisable. Higher quality nets have some or all of the following features: headbands of double or triple thickness, multiple rows of lock stitching, strong mesh, often with extra twine layers woven into the top six rows of netting, heavy-duty galvanized steel cable coated with vinyl, dowels in sleeves at each end of the net and built-in singles sticks.

Center Straps and Anchors

Center straps are used to insure that the center of the net is exactly 3' (914mm) above the playing surface. Straps are height adjustable and are fitted into a ground anchor. Most are 2" (51mm) wide polyester or nylon with a steel swivel hook at the bottom. A non-rusting swivel hook, though somewhat more expensive, may be desirable in corrosive environments.

Center strap ground anchor footings are usually 12" (305mm) in diameter with a minimum depth of 12" (305mm). They are fitted with a cross pin below the surface of the court. It is important that the ground anchor be installed flush with the court and parallel with the net line to avoid twisting the strap. The cross pin in the ground anchor, to which the center strap is attached, should be made of suitable material or treated in such a way as to resist rusting.

Lighting

Tennis court lighting is essential for indoor tennis play and extends the hours of court use outdoors both in winter, when days are short, and in summer, when high daytime temperatures increase the attractiveness of evening play. Proper lighting provides good visibility to follow the ball along its path in play. A properly designed lighting system is economical to install, maintain and operate, is environmentally acceptable (that is, does not allow light to stray outside the court area) and provides adequate levels of quality light.

Planning Lighting

In choosing tennis court lighting, it is important to consider all the variables and select that type of lighting which most closely matches the needs of the particular facility. Variables include light output, efficacy, lamp life, color, degree of control, initial cost and maintenance needs. The choice of a lighting system also will be affected by frequency of use, type of play, climate, the relative importance of light pollution and other factors.

In comparing various lighting plans and light sources, a number of factors must be considered.

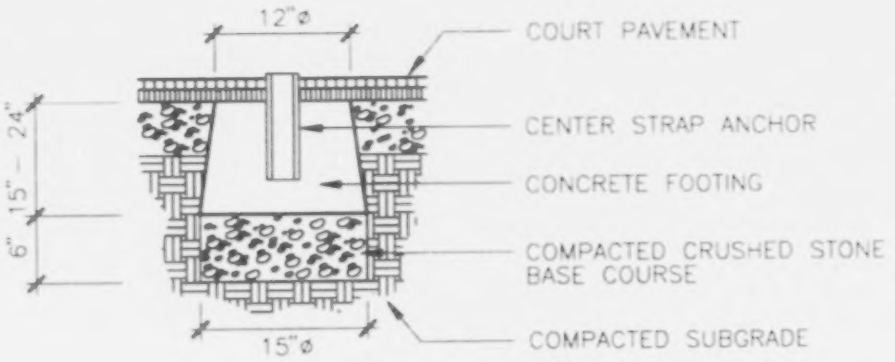
Quantity of Light

The quantity of light required for any sport depends on the speed of the sport, whether the sport is a ground or aerial sport, the skill level of the players, the number of spectators, the distance of the spectators from the playing area, and the number of angles from which spectators and players view the target. Tennis is a fast, aerial sport where players and spectators view the ball, a fast-moving target, from many directions. Therefore, depending on the skill level of the players and on the number of spectators who will be watching, relatively high levels of illumination are required.

In planning levels of illumination, the average age of the players also should be considered. One study showed that a 50-year-old player needed six times as much light, and a 60-year-old player fifteen times as much light, to see as effectively as a 20-year-old player.[4]

4 Tennis Industry Magazine 1992, pg. 10.

NOTE:
IN AREAS SUSCEPTIBLE TO FROST HEAVING, INCREASE FOOTING DEPTH TO 24".



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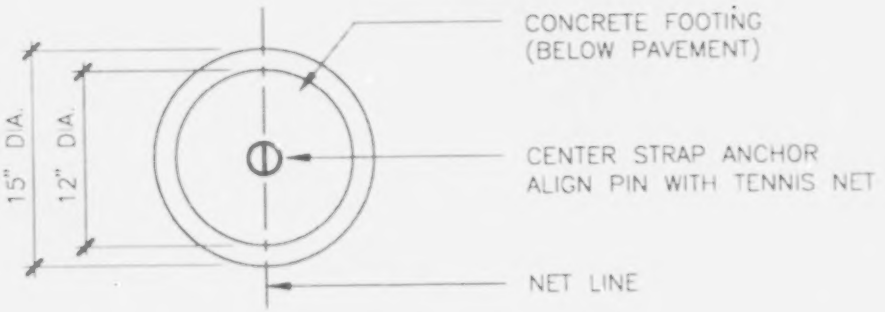

PLAN

TENNIS NET CENTER STRAP ANCHOR

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All lighting systems should be designed to provide adequate visibility of the ball along every possible path while in play, for both players and spectators, with minimum glare.

The USTC&TBA and the USTA recommend the average maintained levels of illumination shown on the chart which follows.

As an aerial sport, tennis requires good illumination measured in both horizontal and vertical planes.

Traditionally, horizontal illumination is measured 3' (914mm) above the playing surface both within the lines and within the principal playing area, or PPA, which is defined as the playing area plus the area 6' (1.829m) outside the sidelines and 10' (3.048m) behind the baselines. Most lighting manufacturers or suppliers can produce a computer-generated point-by-point diagram which will show the levels of illumination in footcandles or lux (the metric equivalent calculated by multiplying footcandles by 10.76) for the lamp, fixture and lighting plan chosen. Levels of illumination also can be measured by an owner with a light meter.

The levels of illumination shown on a plan or discussed in specifications should be average maintained illumination rather than initial illumination. When a lamp (or a light source) is new, it produces a certain level of illumination. Over time, the amount of light produced by the lamp is reduced. This is called the light loss factor (LLF). Most manufacturers count on 20% - 40% depreciation. Climatic conditions, dust and dirt, voltage variations and luminaire design and maintenance will affect the amount of depreciation.

Lighting designers and manufacturers are increasingly recognizing the importance of vertical illumination in planning lighting for tennis. As players lob, serve and run to the net for a volley, they are looking through an infinite number of planes of vertical light. A measure of vertical illumination would indicate the amount of light on the surface of the ball in any given location.

Vertical illumination is a function of the level of illumination, the type of lamp, the mounting height of the light fixture, the aiming and beam spread of the fixture and other factors. It is complicated to measure and to compute. Since tests have shown a direct correlation between horizontal and vertical illumination, however, it is not necessary to compute vertical illumination except when planning courts for use for tournament competition with TV coverage.

Quality of Light

The quality of illumination is a function of uniformity, contrast, color rendition, flicker or strobe, and spill.

Uniformity of illumination refers to the amount of difference in the level of illumination between the darkest spot on the court and the lightest. The greater the variance in light over the principal playing area, the more difficult it will be for players and spectators to follow the ball. A maximum to minimum ratio of 2:1 means the brightest spot on the court (maximum) is twice as bright as the darkest spot on the court (minimum). Although perfect uniformity (or 1:1) is ideal, studies have shown that the human eye can't tell the difference between 1:1 and 3:1. In fact, many people cannot tell the difference between 1:1 and 4:1. A maximum ratio of 2:1 is recommended, however.

Color contrast is necessary to see the ball against the background. Various colors reflect various quantities of the light that falls on them. For example, white tennis balls reflect 70-80% of the light which falls on them while yellow balls reflect 60-70% of the light. Since tennis balls have a high reflectance, tennis court surfaces and backgrounds should have low reflectance to provide contrast. A dark green court surface or background curtain will reflect 15-20% of the light while a medium green will reflect up to 25-30%

RECOMMENDED ILLUMINATION FOR OUTDOOR TENNIS FACILITIES				
PERFORMANCE CRITERIA	RECOMMENDED			MINIMAL
	EXCELLECT	VERY GOOD	GOOD	FAIR
Average Maintained Horizontal Footcandles within PPA 1, 2, 4	125	100 - 75	75 - 50	50 - 30
Minimum Maintained Horizontal Footcandles within PPA 2, 4	100	100 - 60	60 - 40	40
Maximum Uniformity Ratio 3	1.50	1.70	2.00	2.50

Notes:

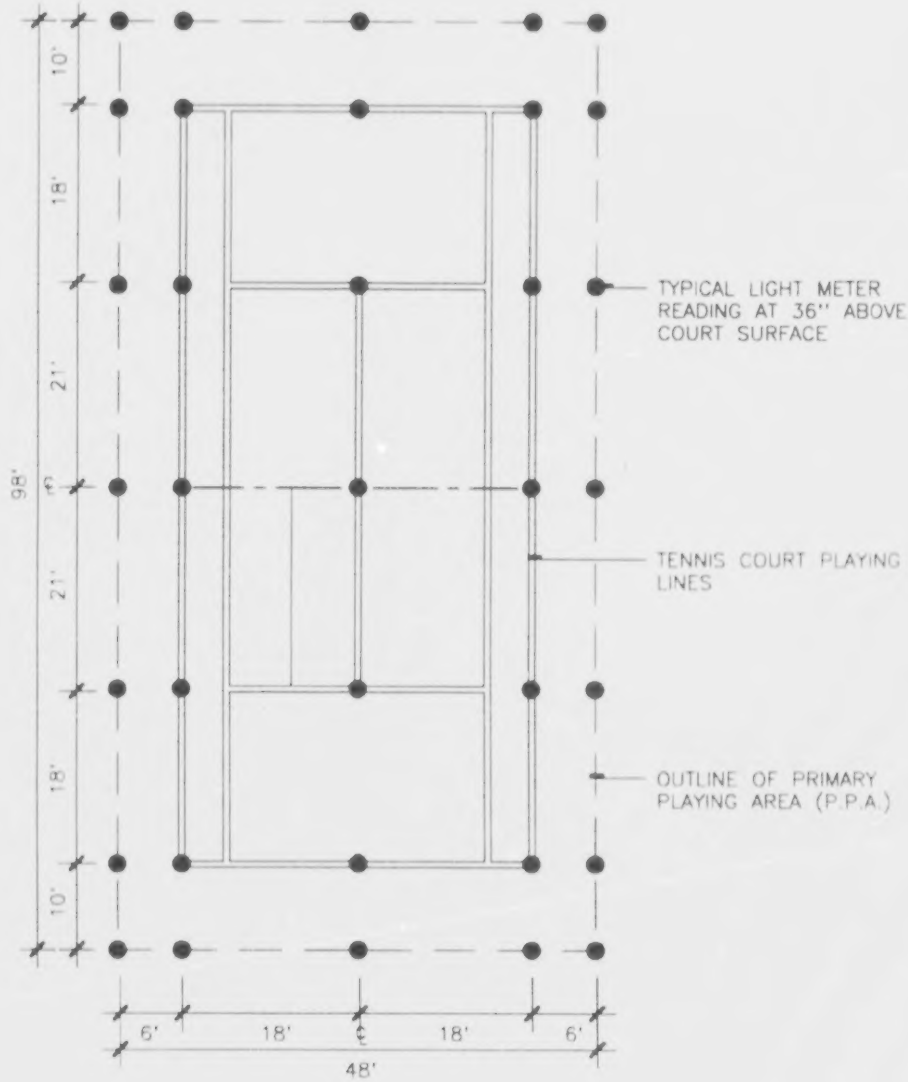
1. Maintained horizontal foot candles is determined by applying a light loss factor (LLF) to the initial calculated or measured foot candles. LLF is dependent upon lamp characteristics, fixture design, fixture maintenance, voltage variations and atmospheric conditions. It normally varies between .6 - .85. Consult the *Illuminating Engineering Society handbook* and fixture manufacturer's publications for proper LLF values.

2. Average maintained and minimum maintained horizontal foot candles should be calculated within the playing lines and/or within the Primary Playing Area (PPA) determined by the specifications of the project with foot candle values multiplied by the appropriate LLF.

3. Uniformity ratio is defined as the ratio of maximum foot candles divided by the minimum foot candles.

4. Primary Playing Area (PPA) is defined as the area that includes 6' beyond the sideline and 10' behind the baseline.

5. For equivalent lux measurements, multiply foot candles by 10.76.



LIGHT METER READING LOCATION DIAGRAM

NOT TO SCALE

L – METER

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Monochromatic green courts or two-tone courts with dark green within the lines and light green outside the lines are traditional but court color is a personal choice. Often two-tone color schemes are chosen in a belief that they will more clearly define the court boundaries. Research has shown, however, that the human eye has difficulty following a moving object across different backgrounds and that two tone courts increase eye fatigue. When color combinations are chosen, the color with the lower reflectance should be used within the court boundaries to minimize glare. Sometimes, however, lighter colors (higher reflectances) of surfacing are chosen in areas where tennis is principally played in natural daylight, because they absorb less sunlight and, therefore, minimize the surface temperature buildup. Less heat absorption on the court not only makes play more comfortable in hotter climates, but reduces thermal stresses on the pavement, which lead to cracking. For night play or for indoor courts, low surface reflectances will require more illumination, particularly since a sufficient amount of light must reflect up from the surface to light the bottom of the ball. Manufacturers of surfacing can provide reflectances for their products in various colors. Manufacturers also can provide information on fading. Designers and/or owners will need to balance visibility, aesthetics, energy use, surface temperature and potential for fading in choosing court surface colors and backgrounds.

Color rendition means whether or not the light source allows the human eye to see colors in the full range of the spectrum. Some light sources, with good color rendition, allow players and spectators to see all colors almost as they could in daylight. Other light sources only allow players and spectators to see a few colors. For more information on color rendition, see the discussion of light sources below.

Strobe results from cycling of electricity on and off within the lamp. Although this cycling is very rapid, it produces some flicker. The eye sees the ball when the lamp is on and doesn't when the lamp is off. The effect is like watching an old time movie. Even with minimal strobe, the ball will appear to be moving a little more slowly than it actually is. Of course, it is possible to adjust to playing under lights with acceptable levels of strobe. Some light sources produce strobe; others don't. For more information on strobe for various types of lighting, see the discussion of light sources below.

Spill is the amount of light which falls outside the area where it is intended to fall. It is sometimes called light trespass or light pollution. Many municipalities and communities have enacted ordinances which limit light spill to as little as one footcandle. The amount of spill is dependent upon the type of lamp (whether it is a point source, one where the light is produced at a single point and, therefore, can be aimed, or whether it is a diffuse source), the type of fixture, the mounting height, the use of reflectors or shields within or around the fixture and the aiming angles.

Outdoor Light Sources (See Chapter VI for information on light sources for indoor tennis.)

There are three light sources for outdoor tennis court lighting.

Incandescent lamps contain a filament, like a common light bulb. Electricity heats the filament, which glows, producing light. Incandescent light sources include tungsten halogen and quartz lamps. Incandescent lighting offers low initial cost, good color rendition, good light control, low strobe and relatively small fixtures. There is no delay in turning incandescent lamps on or off. For this reason, they are well suited for use with timers. Incandescent lights have comparatively short lamp life and relatively low efficacy (lumens/watt, a measure of the amount of light produced for the amount of electricity used), however, and, therefore, higher maintenance and operating costs. Incandescent lamps, particularly quartz, generally require higher poles because they are point light sources. If mounted on low poles, incandescent lamps create hot spots on the court. Higher poles diffuse the light. Since they are mounted on higher poles to diffuse the light, however, often more fixtures are required to achieve the same level of illumination. Individual fixtures must be carefully aimed after installation to minimize glare and achieve uniformity of light distribution. Banks of quartz floodlights, with up to 50 individual lamps on 100' (30.481m) poles, are often used for stadium lighting for televised tournament play.

Fluorescent lamps consist of a tube filled with a gas. Electricity excites the gas molecules causing them to glow, producing light. They are a diffused light source; light is emitted in all directions from the tube. Therefore, they must be aimed using reflectors. Fluorescent lamps offer good color rendition with relatively low glare and low mounting height which makes for easier installation. They can be used with timers because they come on and go off almost instantly. Fluorescent lamps provide relatively high efficacy; however, they are severely affected by low temperatures outdoors. Light output is reduced by up to half at temperatures below sixty degrees. Special low temperature ballasts or lamp shields must be used for cold weather operation outdoors. While commonly used for tennis lighting in the past, fluorescent lights are rarely used today.

High intensity discharge (HID) lamps contain an arc tube filled with gas. When the electricity is turned on, the gas is excited and creates light. They include mercury vapor, metal halide and high pressure sodium. HID lighting requires larger and heavier fixtures than either incandescent or fluorescent lighting, resulting in higher initial cost, though modern shoebox fixtures (sharp cutoff luminaires known for their rectangular shape) are more economical than older models. HID lamps are point light sources; therefore, fixtures include a lens to diffuse the light. Most HID lamps require a 3-12 minute warm up time to achieve maximum light output. When used with timers, they require a warning signal near the end of the cycle so that players can extend the time before the light turns off. Because of the time delay in restarting HID lighting, a back up emergency lighting system is recommended for indoor installations. Quick start HID lamps are available although they have lower efficacy and shorter lamp life than ordinary HID lamps. HID sources produce strobe or flickering which can be minimized by connecting lamps on alternating phases to a multi-phase power system. Aiming must be coordinated between lamps on different phases to yield constant illumination. The major benefits of HID lighting include long lamp life, high levels of illumination, good quality illumination and high efficacy. Properly designed, HID lighting systems generally require fewer fixtures which may offset some of their higher initial cost.

Metal Halide - Metal halide provides good color rendition, high efficacy, good lamp life and good light control, making it the most popular source for tennis court lighting today.

High Pressure Sodium - High pressure sodium has higher efficacy and longer lamp life than metal halide, but it has the most visible strobe effect and provides poor color rendition. Only yellow and orange are clearly visible, so its use for tennis, which requires good contrast, is not recommended. Some states and municipalities are urging the use of high pressure sodium, however, as an energy conservation measure.

Mercury Vapor - Mercury vapor lamps provide long lamp life, but are rated only fair to poor in color rendition and efficacy.

Both fluorescent and HID light sources use ballasts; ballast hum may be annoying to players. Remote mounting of ballasts eliminates the distraction to players, makes ballasts more accessible for maintenance, usually provides better cooling and reduces the weight of the luminaires.

Lighting Fixtures

Traditionally, fluorescent lamps were mounted in strip fixtures 13' (3.962m) - 22' (6.706m) above the surface outside and parallel to the sidelines of the court. They were once common but, now, are rarely used.

Incandescent (quartz) lamps are mounted on high mast lighting, including heavy duty and general purpose floodlights. Heavy duty floodlights include a weatherproof housing with a removable reflector and a hinged cover glass which protects the lamp from weather, dust, etc. General purpose floodlights consist of a weatherproof housing which acts as a reflector. They may include a cover glass. Floodlights should be mounted not less than 35' (10.668m)

COMPARATIVE CHARACTERISTICS OF LIGHT SOURCES FOR GENERAL LIGHTING PURPOSES

	LUMEN OUTPUT PER LAMP	EFFICACY	LIFE EXPEC-TANCY	COLOR ACCEPT-ABILITY	DEGREE OF LIGHT CONTROL	MAINTAINED LIGHT LEVEL
INCANDESCENT	FAIR	LOW	LOW	HIGH	HIGH	GOOD
TUNGSTEN HALOGEN	FAIR	LOW	LOW	HIGH	HIGH	HIGH
MERCURY	GOOD	FAIR	HIGH	LOW	GOOD	GOOD
PHOSPHOR MERCURY	GOOD	FAIR	HIGH	FAIR TO GOOD	FAIR	FAIR
METAL HALIDE	HIGH	GOOD	GOOD	GOOD TO HIGH	GOOD	FAIR
HIGH-PRESSURE SODIUM	HIGH	HIGH	GOOD	FAIR TO LOW	GOOD	GOOD
40-WATT FLUORESCENT	LOW	GOOD	GOOD	GOOD TO HIGH	LOW	GOOD
HIGH-OUTPUT FLUORESCENT	FAIR	GOOD	GOOD	GOOD TO HIGH	LOW	GOOD
1500-MA FLUORESCENT	GOOD	GOOD	FAIR	GOOD TO HIGH	LOW	FAIR

Comparative characteristics of light sources for general lighting purposes. There are four ratings for each characteristic – high, good, fair, and low.

In evaluating the selection of a light source, the focus should not necessarily be on the one which exhibits the highest combined characteristics; rather it should be on the one having characteristics which most closely answer the particular needs of a facility. One installation may be most concerned with efficacy and energy use, another with the lamp's life span, and still another with the color acceptability and lumen output. The selection process would first establish the order of importance of each characteristic for the facility to be lighted, and then identify that source which best meets the requirements.

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above the ground for aerial sports such as tennis; the higher the pole, the greater the setback required from the playing area in order to light the sides of the ball as well as the top. High mast poles often result in considerable light spill and can cause blinding glare when looking up into them for a lob or serve. For this reason, floodlights are most often used on very high poles for stadium court lighting.

Low mast lighting for HID lamps is installed using sharp cut off luminaires. Sharp cut off luminaires shield the light to reduce glare while providing broad coverage on the playing field. Because sharp cut off luminaires direct light to specific areas, they reduce light pollution or spill. Sharp cut off luminaires can be mounted on lower poles (20' (6.096m) - 25' (7.620m)) and require fewer fixtures (6-8 per court). Their lower pole height makes cleaning and changing lamps easier, reducing maintenance costs. These advantages make them the most popular system for tennis court lighting. Most use a 1,000 watt or 1,500 watt metal halide lamp, although some accommodate two 1,000 watt lamps. The major disadvantage to low mounted shoebox systems is that lobs are less visible in the dark above the luminaires.

Both incandescent and HID lamps are available in either open or closed fixtures. Closed fixtures generally have higher initial cost but reduce the light loss factor and require less maintenance.

Timers

Several types of timers are available for use with tennis court lighting. For example, photoelectric cells can be used to switch lights on at dusk and off at dawn. Photoelectric cells are a simple, inexpensive system to install but can be expensive to operate since lights burn all night whether or not anyone is playing. In addition, such systems may violate light pollution ordinances.

Time clocks are another option. They can be preset to turn lights on and off at a given time each day or programmed to turn lights on and off at different times on different days.

Interval timers can be used to light courts for a given period of time. These timers can be attached to coin-operated, token or key-card systems if the owner wants to control use of lighting or require payment.

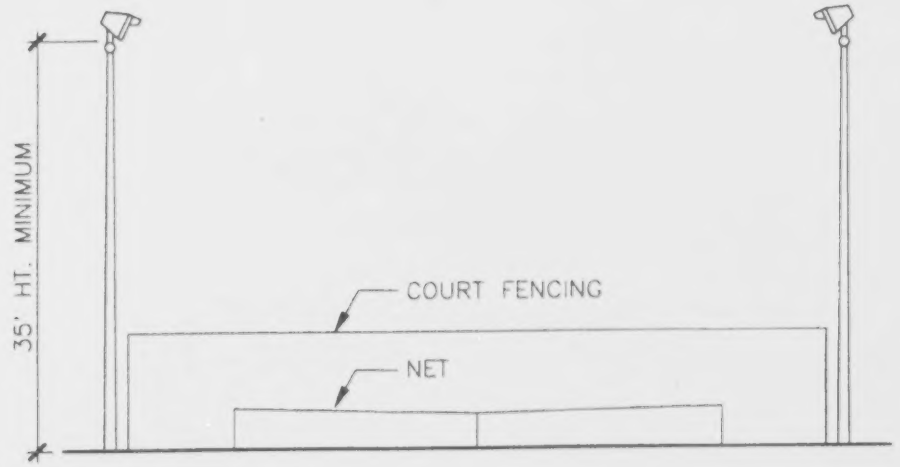
Fluorescent and incandescent lighting systems, since they turn on and off immediately, are best suited for use with timers. HID systems can be used with timers, but since they take 3-12 minutes to reach full power after being switched off, they should be used with a visible or audible warning signal before the end of the cycle to allow players to reset the time and avoid interruption of play.

Complex timing systems may involve use of several types of timers. For example, a photoelectric cell may limit the use of lights before dusk, while a time clock prevents play after 11:00 p.m.

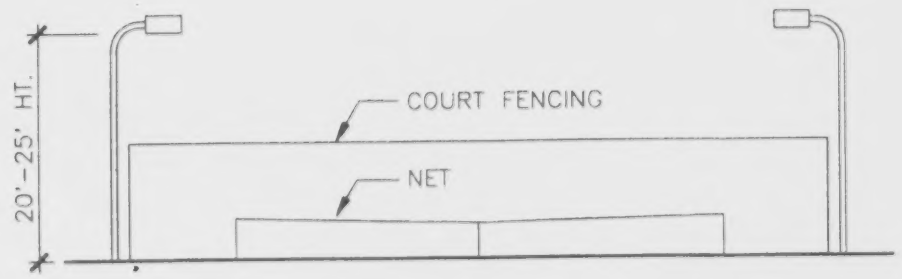
Short and Long Term Cost

When planning tennis lighting, consider both short and long term costs. Lamps, fixtures and poles vary considerably in their initial installation cost. Lamps also vary considerably in their efficacy which is measured in lumens/watt — the amount of light output per watt of electricity. The figures used in calculations below are examples only and may vary from manufacturer to manufacturer.

Metal halide lamps, for example, produce an average of 110,000 lumens/1,000 watts. Using this information, an owner can calculate and compare the initial and long term costs of various lighting systems. After determining the cost of installation and the number of fixtures necessary to produce the desired level of illumination (perhaps with



HIGH–MAST LIGHTNIG



LOW–MAST LIGHTING

TYPICAL COURT LIGHTING SECTIONS

NOT TO SCALE

LIGHT – 1

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the aid of a point-by-point diagram produced by a lighting manufacturer or supplier), multiply the number of fixtures by the wattage per fixture by the number of hours they will be used per year and divide by 1,000 to determine the number of kilowatt hours of electricity to be used in a year. Multiply the number of kilowatt hours by the cost per kilowatt hour in the area to determine the average cost to operate that lighting system. Then compare the cost of installation and the cost of operation.

For example, the typical metal halide installation requires 6-8 fixtures per court. Each fixture requires 1,000 watts of electricity. If the lighting is used four hours per day for 360 days per year (1,440 hours per year), the calculation is 6 X 1,000 X 1,440/1,000 = 8,640 kw hours per year. If the cost of electricity is $.10 per kilowatt hour, the cost to provide lighting for that court will be $864 per year or $.60 per hour. This figure can be easily compared with the figures calculated for other lighting systems.

Of course, the relative importance of initial cost versus operating cost is dependent on the number of courts as well as on the frequency and the length of time the lighting will be used.

Another factor which affects long term cost is lamp life. The more quickly lamps burn out, the more frequently they must be replaced. The cost per lamp, its expected life and the cost of labor to replace lamps must be considered. Manufacturers list the average lamp life of their products. Average lamp life is determined by testing 100 bulbs. They are turned on; when half are burned out, that time is considered the average lamp life. Lamp life will be reduced if lights are turned on and off frequently. Metal halide lamps commonly list average lamp life as 12,000 hours.

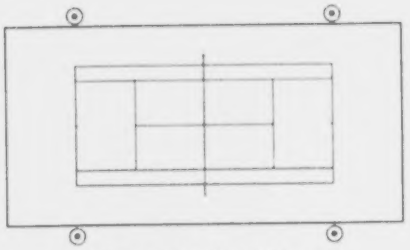
Location of Fixtures

Lighting fixtures should be located outside playing lines, preferably parallel to the alley lines and outside the fence. On fast dry courts, location and selection of fixtures is particularly important since rain dripping off fixtures can damage the fast dry surface. Fixtures should be aimed to project light across the court to eliminate glare. When lighting a multiple court facility, no light poles should be placed between courts except at the net line unless there is at least 24' (7.315m) between courts. Any free standing lighting fixtures located inside the fence and more than 1' (305mm) from the fence should be heavily padded to reduce player injuries. Since players often stand at or behind the baseline during play, at least one fixture per side behind the baseline is recommended. Special caution should be exercised, however, to insure that fixtures are placed in such a way that players do not have to look directly toward a light behind the opposite baseline when serving or during normal play. For this reason, no lighting fixtures should be placed at the back of the court behind the principal playing area and lighting fixtures located at the corners should be on poles no less than 35' (10.668m) high and should be carefully aimed.

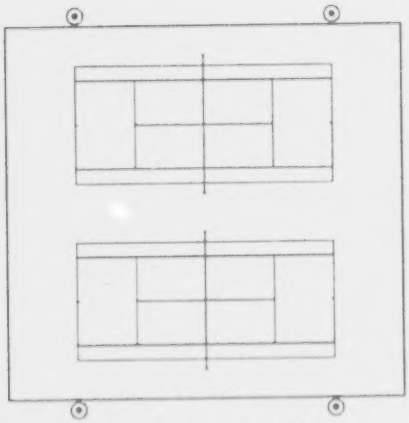
Light Poles

Steel light poles were once the standard and are still common; today, however, many poles are made of aluminum. Fiberglass poles are available, but they are very expensive. Concrete poles are sometimes used as well. Some suppliers offer baked-on polyester or vinyl finishes, making poles more attractive, allowing them to be color coordinated with net posts, fencing, etc. and providing protection against weathering. The National Electrical Code requires that light poles be manufactured and used for the purpose of supporting lighting fixtures. They cannot serve as fence posts.

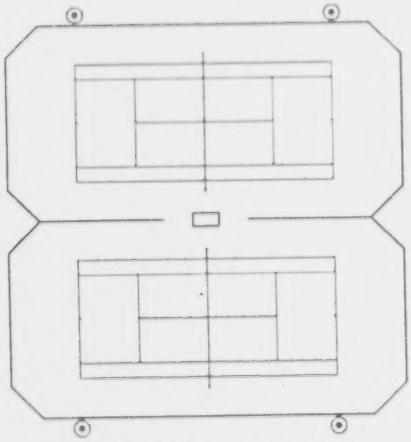
Poles should be designed to withstand wind velocities as required by local codes. In coastal areas or other areas with potential for high winds, wind resistance of not less than 150 mph is recommended.



ONE COURT LAYOUT



TWO COURT LAYOUT



TWO COURT LAYOUT
W/ CUT CORNERS

NOTES:
LIGHT FIXTURE HEIGHTS SHOULD BE 35' MIN. TO MINIMIZE GLARE IN PLAYERS' EYES.

RECOMMENDED LIGHT LEVELS:

1. EXCELLENT	125 FC
2. VERY GOOD	75 FC
3. GOOD	50 FC
4. MINIMUM	40 FC

TYPICAL COURT LIGHTING–HIGH MAST

NOT TO SCALE

LIGHT – HM

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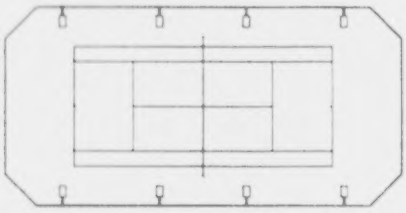
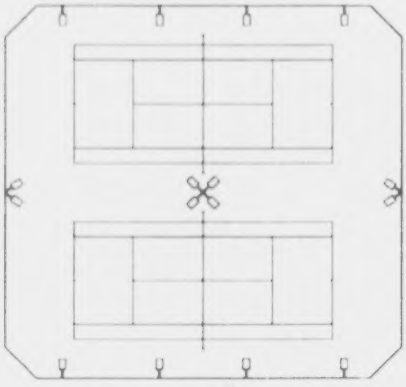


ONE COURT LAYOUT

NOTES:
NUMBERS OF LIGHT POLES, HEIGHTS, AND SPACING VARIES BY MANUFACTURER

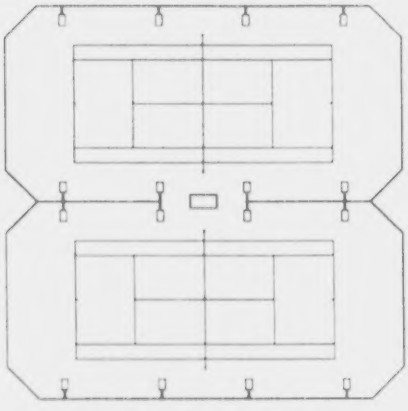
RECOMMENDED LIGHT LEVELS:

1. EXCELLENT	125 FC
2. VERY GOOD	75 FC
3. GOOD	50 FC
4. MINIUM	40 FC



OFFSET GATE FOR LIGHT POLE, TYP.

TWO COURT LAYOUT



TWO COURT LAYOUT
W/ SHADE SHELTER

TYPICAL COURT LIGHTING–LOW MAST

NOT TO SCALE

LIGHT – LM

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117

HID fixtures can be mounted at 20' (6.096m) - 25' (7.620m). Floodlight type fixtures require poles that are a minimum of 35' (10.668m) high.

Poles are available in either anchor bolt base plate or direct burial models. Anchor bolt base plate poles feature a base plate which is attached to anchor bolts installed in the post footing. Direct burial poles have extended shafts which are set directly into concrete footings.

Whether for use with anchor base or direct burial poles, concrete footings should be engineered for specific installations, climatic and site conditions.

Wiring

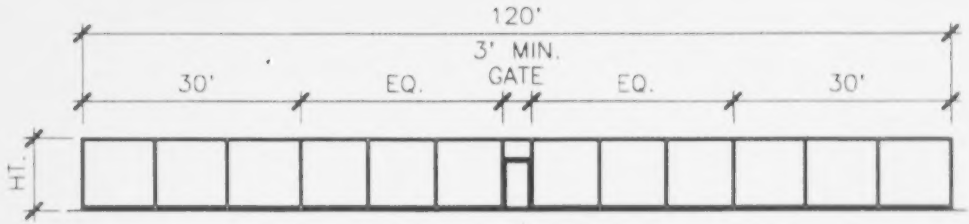
Underground wiring outside the court area is recommended. All wiring must comply with the National Electrical Code and with applicable state and local codes. A 277/480 volt three phase system is commonly used for large installations and a 120/208 volt single phase system is used most often for smaller installations. Wiring for multiple court facilities should be designed so that lighting for each court can be operated individually. When installing electrical wiring for light poles, it is advisable to install a duplex outlet at the base of the pole for ball machines or maintenance equipment.

Fencing

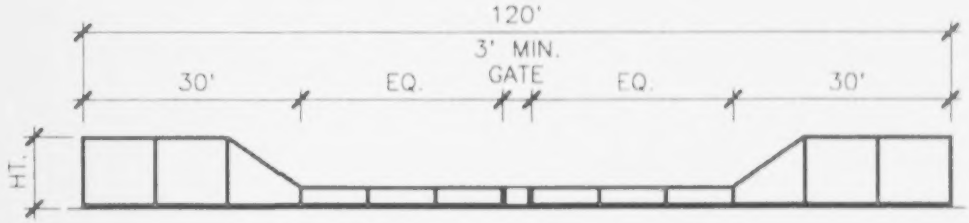
The purpose of fencing around a tennis court is to keep most balls within the court during play. Traditionally, tennis courts have been surrounded by fencing with an overall height of 10' (3.048m) - 12' (3.658m), with 10' (3.048m) fencing being standard. The height of fencing required in a particular project depends, to some degree, on the tennis court surface. Different surfaces have different bounce characteristics. Ten foot (3.048m) fencing is used in most hard court applications, while 8' (2.438m) fencing is probably adequate for most soft court projects and for many residential courts. Five foot (1.524m) fencing may be adequate for grass courts because of the low bounce encountered with grass. On the other hand, on rooftop courts or other locations where a ball which goes over the fence may be a hazard or cannot be retrieved, where retrieving such a ball would require an unwelcome intrusion on neighboring property or at high elevations where the ball bounces higher due to the thin air, 12' (3.658m) fencing is recommended.

All around fencing may be traditional, but it is not necessary for play. The purpose of the fence in tennis is similar to that of the backstop in baseball; it prevents the ball from going out and returns it to play. Unless fencing is required for security reasons or for safety, as on a small site where parking lots, water hazards or other obstructions are located nearby, when windscreens will be installed, where animals may wander across the court (deer, for example, are particularly hard on tennis court surfaces) or for rooftop courts, perimeter fencing entirely surrounding a court is not required. In fact, with all around fencing, players feel as though they are playing in a cage. The best environment for tennis is one with the least amount of fencing required for the particular site and use.

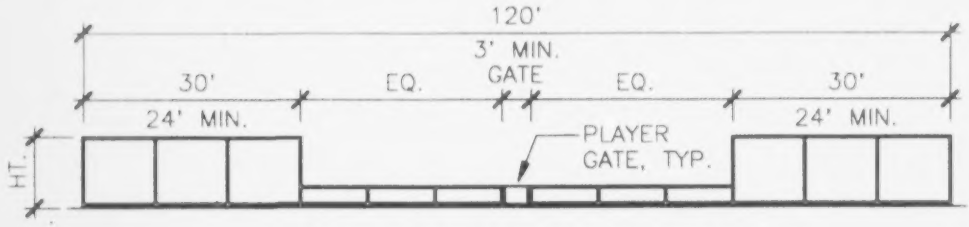
For purposes of play, fencing is required across the back of the court and along each sideline from the corner 20' (6.096m) - 40' (12.192m) up the sidelines. The area up to 40' (12.192m) on either side of the net can be left open, or 3' (914mm) fencing can be continued to contain rolling balls. A common configuration is to continue fencing 30' (9.144m) up each sideline with the middle 60' (18.288m) left open. These open configurations save money on fencing while providing enough fencing to keep all but a few balls within the court. They also improve visibility for spectators. Leaving an open section in the middle of the court provides room for shade shelters, benches and drinking fountains between courts and provides access for maintenance equipment.



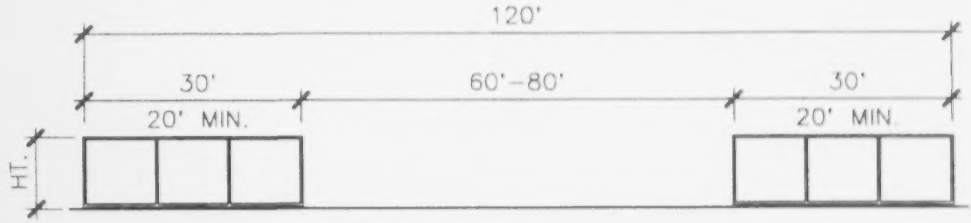
FULL HEIGHT SIDE FENCE



SIDE FENCE W/TAPERED DROP MIDDLE



SIDE FENCE W/DROPPED MIDDLE



SIDE FENCE W/OPEN MIDDLE

NOTE: FENCE HEIGHT VARIES BY SURFACE TYPE.

10' MIN.	ASPHALT AND CONCRETE
8' MIN.	CLAY, FAST DRY, & SAND-FILLED TURF
5' MIN.	NATURAL GRASS
3' MIN.	PREFERRED HEIGHT FOR VIEWING INTO COURT

TYPICAL SIDE FENCE ELEVATIONS

NOT TO SCALE

FENC - ELV

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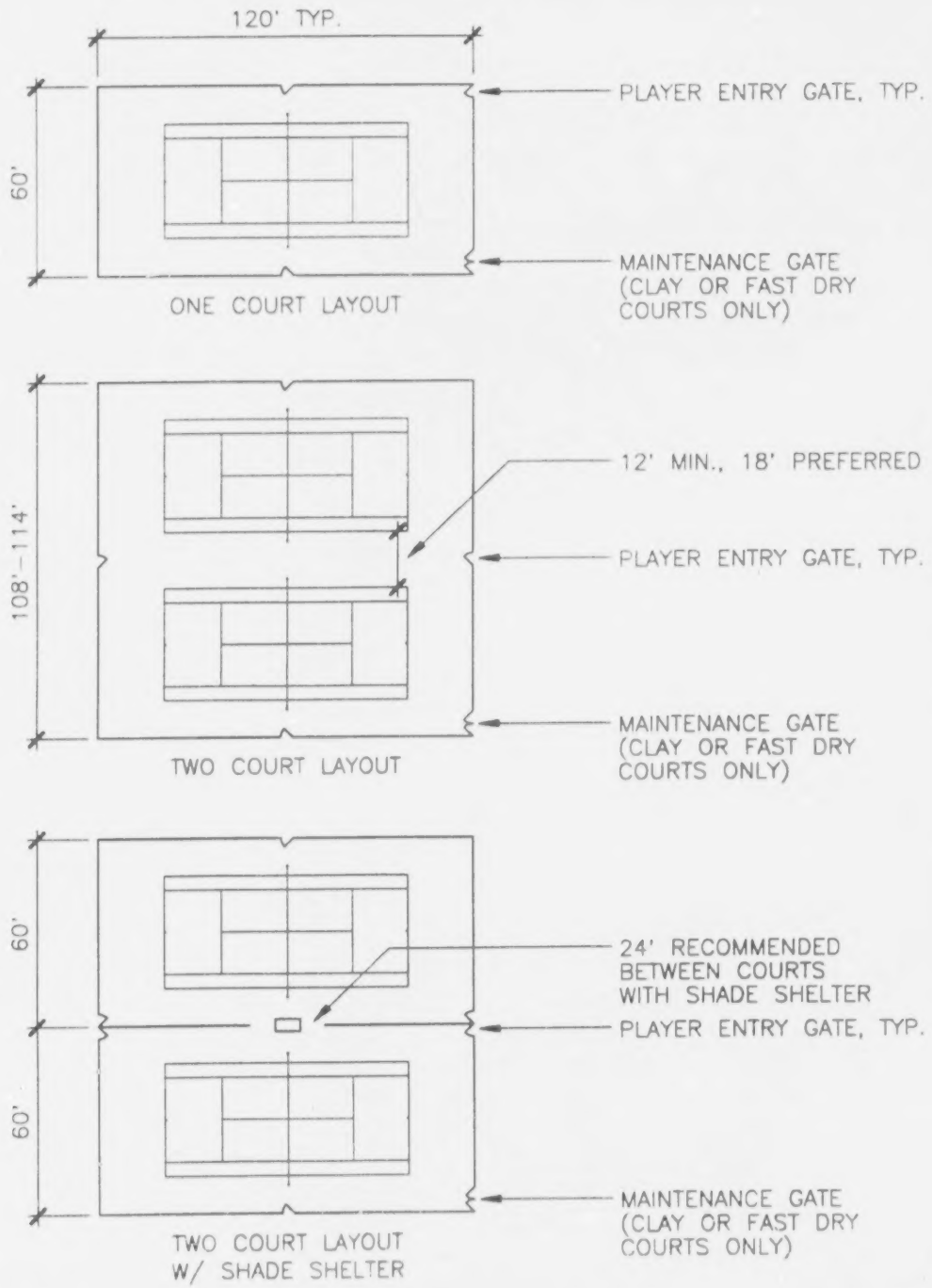

TYPICAL FENCE PLANS–SQUARE CORNER

NOT TO SCALE

FENC – SQ

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120

An alternative to the traditional rectangular court features diagonally cut corners. Eliminating both fencing and surfacing for the unused corners, this type of court is cost effective, softens the look of the court and provides an area for landscaping. The diagonal corners also deflect balls back toward the center so that players do not have to retrieve them from deep in the corners. Typically, such corners have a 10' (3.048m) diagonal which cuts 7' (2.133m) off each corner or a 14' (4.267m) diagonal which cuts 10' (3.048m) off each corner. Where two or more courts are installed in a bank, "Vs" are used between courts. This configuration also may be useful to maintain maximum court size on smaller sites or on sites with buildings or other obstructions.

A fence mesh of 11 gauge core wire with a 1 3/4" (44mm) diamond pattern is recommended to prevent balls from sticking in the fence. This type of fencing is commonly called "tennis court fabric." It is a smaller mesh, less readily available and more expensive than the 2" (51m) industry standard chain link used for other purposes. Nine gauge core wire with a 2" (51mm) diamond pattern also works to prevent balls from sticking. If windscreens are used, balls never come in contact with the actual fencing material so standard chain link may be used to reduce costs. Another cost cutting option is to use 11 gauge with a 1 3/4" (44mm) diamond mesh or 9 gauge with a 2" (51mm) diamond mesh on the ends of the court and standard chain link on the sides.

The fence mesh always should be affixed to the court side of the posts to prevent erratic ball bounces off posts, to reduce the potential of players injuring themselves running into posts and to facilitate the installation of windscreens.

Vinyl clad fence fabric and frame is preferred, although galvanized fencing also is used when cost is a consideration. Vinyl clad fencing is more expensive than galvanized fencing, but provides benefits in terms of durability and aesthetics. Particularly in highly corrosive environments (such as inner city areas where there is a high level of pollution, or in seaside areas where exposure to salt water is hard on fencing), vinyl clad fencing is highly recommended. Fence coating comes in standard colors of green, black or brown; color coated fences can help tennis courts to blend into their surroundings, enhancing their appearance.

Galvanized fencing and posts, if used, should be free from barbs or other projections which sometimes occur in the galvanizing process. These sharp projections may constitute a player or spectator hazard. After a suitable period for oxidizing or after priming, galvanized fencing may be painted, or it may be covered with background curtains to reduce glare. As an alternative to galvanized fencing, the newer aluminized fencing and posts can be used.

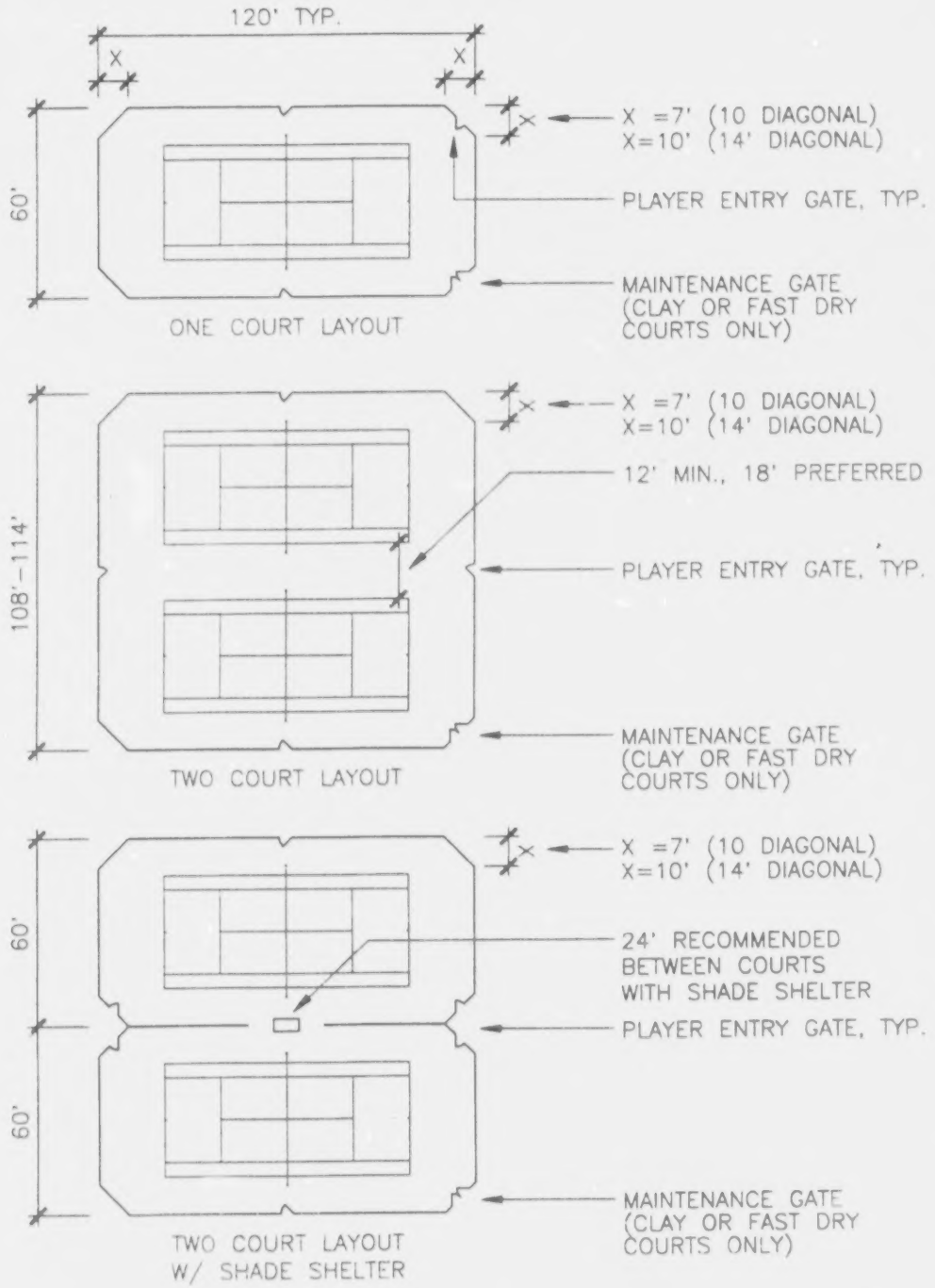
Fencing, whether vinyl clad, galvanized or aluminized, should have selvages or edges, both top and bottom, bent double (knuckled) to prevent injuries and to minimize debris from collecting against the fence.

Sometimes vinyl clad fence fabric is combined with a galvanized framework. A galvanized fence framework may be painted to match vinyl clad fabric.

The framework for a 10' (3.048m) high fence should have a minimum strength of schedule #40 or equal. All gate and terminal posts should be at least 2 1/2" (64mm) square or 3" (76mm) round posts. Line posts should be at least 2 1/2" (64mm). These dimensions are nominal and actual dimensions are slightly smaller. If the fence is higher or if excessive loads (wind, snow, etc.) are expected, larger framing may be required.

All posts should be set on 10' (3.048m) centers or less. If windscreens are to be installed, consideration should be given to installing the line posts on 8' (2.438m) centers or less and/or to increasing the size of the line, gate and terminal posts to 3" (76mm).

Fence fabric is attached to line posts with wires every 12" (305mm). The fabric is attached to terminal and gate posts with tension bands and tension bars, 12" (305mm) on center, one less than the height of the fence, but no fewer than three.



TYPICAL FENCE PLANS–CUT CORNER

NOT TO SCALE

FENC – CUT

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Fence posts should be set in cylindrical concrete footings not less than 10" (254mm) in diameter (or four times the diameter of the post) and a minimum depth of 6" (152mm) below the frost line but not less than 36" (914mm) deep. The depth of the footing depends on soil conditions at the site and on the amount of freeze-thaw activity.

Top rails are usually installed on all chain link fences for stability and appearance. The top rails pass through openings provided in fence post caps and are joined together by sleeve couplings. The fence fabric is tied to the top rail at intervals of approximately 24" (610mm).

Although mid rails are sometimes installed for stability, they are recommended only for longer runs of fencing, where 12' (3.658m) fence is used or where strong wind or ice loads are expected. Although mid rails add stability, they create a horizontal line on the background at the level of play which may distract the player trying to see the ball. In addition, mid rails can create a hazard if players run into the fence. Mid rails off corner posts and terminal posts on fence runs over 60' (18.288m), however, may be necessary to tension the fence fabric and to create a neat appearance. If used, mid rails should be connected with boulevard clamps for strength and stability.

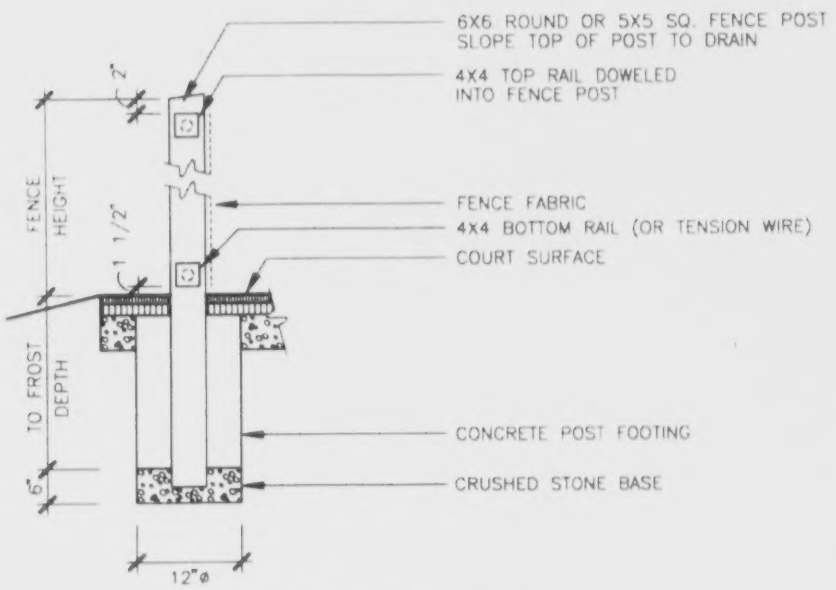
A bottom rail will help to keep the fence fabric from bulging and will give the fence a neat, finished appearance. A bottom rail also may help to prevent players from sliding under the fence. In lieu of a bottom rail, a bottom tension wire is sometimes used to keep the fence fabric taut. A tension wire is less expensive; however, it may pose a hazard to any player attempting to reach under the fence to retrieve a ball or to any player sliding under the fence. If neither a bottom rail nor a tension wire is used, it is likely the fence will curl up causing an unsightly appearance, as well as a hazard to players.

An adequate number of gates should be installed to allow access to each court. Two gates at opposite corners are a plus, making it easy for players to retrieve balls which go over the fence. Pedestrian gates usually are 3' (914mm) -4' (1.219m) wide. The Americans with Disabilities Act (ADA) requires that accessible gates into courts be at least 32" (813mm) wide. Gate openings of 4 1/2' (1.372m) are recommended to accommodate maintenance equipment. Where several soft courts are surrounded by a single enclosure, at least one double swing gate a minimum of 8' (2.438m) wide is highly desirable. Such a large gate allows heavy equipment to enter the court for annual resurfacing. A large gate is usually unnecessary on a hard surface court since resurfacing is required only every few years.

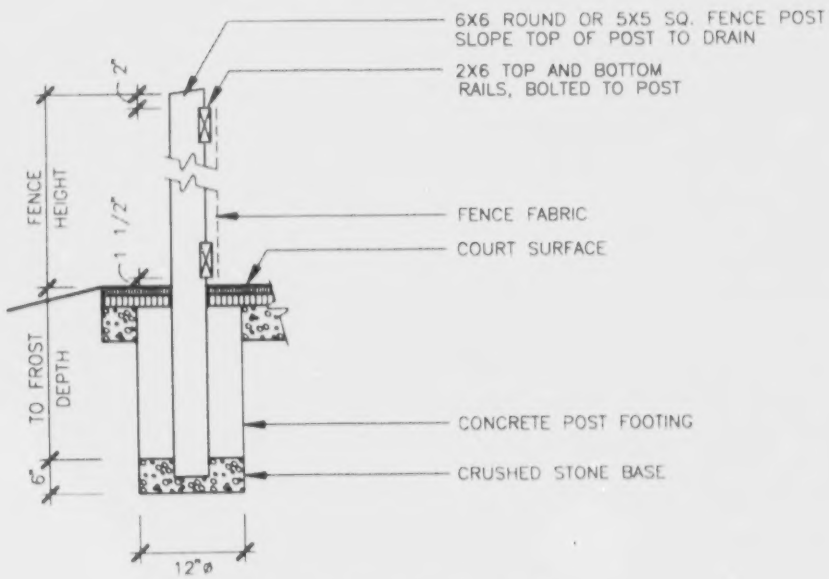
Chain link fabric or soft fence fabric such as windscreen or divider netting also can be installed on a wooden framework. Both weather resistant untreated woods, such as cedar, and pressure-treated woods are used. The use of pressure treated wood in ground causes some environmental concern; however, its manufacturers insist that when properly used, it shows no harmful effects to the environment. Both age naturally to a grayish color or they can be stained or painted. When using wooden framework, at least a 4" (102mm) X 4" (102mm) post and a 4" (102mm) X 4" (102mm) rail, doweled into line posts, is required, with 5" (127mm) X 5" (127mm) preferred. When using round post and rail fencing, a minimum diameter of 4" (102mm) should be used. Posts should be spaced a maximum of 8' (2.438m) -10' (3.048m) on center and installed in the ground at least 30" (762mm). In areas of freeze-thaw activity, installation 6" (152mm) below the frost line, but not less than 30" (762mm) is recommended.

Untreated wood posts are installed in gravel footings 12" (305mm) in diameter. Installing untreated wood in concrete footings is not recommended since the moisture in the concrete can cause premature rotting of the wooden post. Pressure treated wood posts can be installed in concrete footings, but it is recommended that a 6" (152mm) gravel base be installed at the bottom of the post.

When constructing a wooden fence, mid rails may be installed for support at the corners and ends, but are optional elsewhere. Bottom rails also are optional but help to keep the fence fabric taut and to give the fence a finished appearance. A bottom tension wire may be used in lieu of a bottom rail.



WOOD FENCE W/4X4 RAILS



WOOD FENCE W/2X6 RAILS

TYPICAL SECTIONS
TREATED WOOD FENCE POSTS

NOT TO SCALE

FPOST – 1

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Once the wooden framework is constructed, fence fabric is stretched and secured to the frame with 1 1/2" (38mm) galvanized staples or other fasteners.

Such non-traditional fencing aids the court in blending into its environment. Wood fences can be designed with customized lattice and decorative post caps and can be stained or painted to match surrounding structures. The use of soft fence fabric (windscreen fabric or divider netting), however, limits the use of accessories which are normally hung on fencing.

Windscreens

Windscreens (sometimes called background curtains) serve many purposes; among these, windscreens 1) provide visual contrast for better ball definition, 2) reduce reflection of the sun's glare off chain link fencing and posts, 3) reduce and/or deflect the wind, 4) provide privacy and screen out annoying distractions such as passersby, parking lots, etc., 5) help tennis courts blend into their surroundings, and 6) help contain artificial lighting at night. The relative importance of these factors may help to determine the preferred features of the windscreen. For a tennis garden or other natural setting, hedges, various vines such as jasmine or ivy, or other landscape materials also can serve these purposes. Use caution in selecting vines that do not attract bees or other annoying insects.

For ball visibility, the darker the background, the better the ball definition. Therefore, a fine mesh in black or dark green is preferred. Windscreens come in 6' (1.829m), 7' (2.134m) and 9' (2.743m) heights. Six foot (1.829m) screening is standard. Nine foot (2.743m) screening is recommended for background purposes for competitive play. Nine foot (2.743m) windscreens also help to contain light on the court (a cost benefit as well as an environmental benefit), and reduce the amount of dust and debris which accumulates on the court. The standard length for windscreens is 60' (18.288m).

Windscreens serve many purposes, most importantly providing a background against which to see the ball. PHOTO COURTESY WELCH TENNIS COURTS, INC.

For wind reduction, the degree of effectiveness is directly proportionate to the size and density of the mesh. Windscreens are generally described as either open mesh or closed mesh. In many situations, open mesh screens provide sufficient background and sufficient windbreak. They are generally less expensive than closed mesh screens and allow better ventilation on the court. Closed mesh provides a darker background and more completely screens out distractions and reduces wind.

In choosing a windscreen product, severe weather and fence strength must be considered. Closed mesh screens greatly increase the stress on fencing during severe weather. In areas of heavy winds, 6' (1.829m) and/or open mesh

windscreens should be considered. Such screening normally provides enough wind flow either through or around the screen to minimize or eliminate any risk to fencing. If the fencing to which the screen is to be attached is not reinforced, open mesh and/or 6' (1.829m) screening also is suggested. For windscreens of 9' (2.743m) or over, regardless of mesh size, air vents should be placed no more than 10' (3.048m) apart and the screens should be tied, roped or otherwise fastened at the midpoint.

The first windscreens were made of green-painted canvas. Today, most windscreens are made of synthetics, commonly polypropylene, vinyl coated polyester or polyethylene. Each has its advantages and disadvantages. Polypropylene products in the heavier grades offer highly effective wind resistance and a very dense background at a reasonable cost. They do, however, shrink, stretch and fade. Vinyl coated polyester screens do not shrink, stretch or fade, but they are somewhat more expensive and offer somewhat less wind resistance. Both polypropylene and vinyl coated polyester are fabricated into windscreens; that is, they are hemmed on the edges and fitted with grommets for attachment to the fencing. The newest entry in the windscreen market is woven polyethylene which is sold both fabricated and unfabricated. The unfabricated version is sold on rolls and is cut by the consumer and hung on the fence using button-holes in the tightly woven selvage edge. The lack of fabrication means that this type of windscreening is inexpensive and easy to patch or replace. Polyethylene windscreening provides modest wind resistance and doesn't fade, but it does stretch and it is less effective as a background than traditional windscreen fabrics.

The quality of the finishing is an indication of the quality of screening. All hems should be reinforced and should have two rows of stitching. Grommets should be No. 2 or No. 3 solid brass, 12" (305mm) - 18" (457mm) on center.

Windscreens should be carefully attached to the inside of the fence. If a windscreen is not properly anchored to the fence, the wind can whip it around and destroy it. For information on the installation and use of windscreens, see Chapter VII.

Divider Nets

If divider nets are planned, adequate mounting posts, support cables and hangers must be incorporated in the design. Divider nets should not be hung on fence posts. For outdoor use, the type of mesh, the height of mounting, the type of fasteners and the mode of installation are all important in protecting the nets during strong winds.

Nets are available in three materials: polypropylene, knitted polyester and nylon. All three materials either stretch or shrink. Polypropylene is inexpensive, but is subject to fading. Knitted polyester has excellent weather resistance; it is color fast and long wearing. Knitted polyester and polypropylene nets come in stock sizes. Nylon has good weather resistance and can be spliced to create one-piece nets in custom sizes. Divider nets may be solid (usually vinyl) or mesh or a combination with a mesh top for ventilation and a solid bottom, but only mesh nets are recommended for use outdoors.

The top of divider nets should be strung 10' (3.048m) - 12' (3.658m) above the surface of the court. Twelve foot (3.658m) nets are preferred to keep balls on the court. The bottom of the netting should not be anchored to the surface in any way nor should nets drape on the surface as this can lead to player injury. Because nets which drag on the surface are subject to significant abrasion, to extend the life of the netting and to minimize the player hazard, they can be hung 1/2" (13mm) -2" (51mm) above the surface of the court. Some nets include a detachable bottom which can be removed when worn.

Divider nets are generally available in green and black. One current trend is to color coordinate all accessories, and manufacturers are responding by offering greater color choice. Courts are being built with net posts, windscreens, light poles, fixtures and accessories, all in the same color.

Maintenance Accessories

For information about court maintenance equipment, see Chapter VII.

Competition Accessories

When a court is used for tournament competition, a number of additional items of equipment are required or desirable. When installing any equipment (such as umpire chairs) temporarily, be certain to protect the court surface from damage with a cushion mat or plywood.

Umpire Chairs

Temporary or permanent umpire and linesmen chairs should be considered in the design of competition courts. The following dimensions are recommended:

	Minimum	Maximum
Height of Seat	63"	94"
Width of Seat	22"	26"
Overall Width	28"	34"
Overall Length at Bottom	44"	48"
Distance from the Net Post	24"	60"

It is particularly important that temporary chairs be constructed in such a way and of such materials that they do not mar the court surface. The chair must be placed far enough from the net post to allow the players to pass through on side changes and also where it will not obstruct the flight of the ball in play. A desk or wide area for a writing surface and a shade covering, such as an umbrella, are highly recommended.

Net Tensioning System

For protection of the net and net posts and for proper play of balls off the net, the net cable should be tensioned at 500 lbs. (227kg). Net set up by height control methods alone is ineffective and may cause damage to net posts and footings.

Net tautness may be set by suspending a 24 lb. (11kg) weight from the center of a singles net or a 14 lb. (6.4kg) weight from the center of a doubles net. Wind the net slowly to a center height of 36" (914mm). Install the center strap and adjust it to maintain the height of 36" (914mm). Remove the weight. This method produces a net cable tautness of 500-550 lbs. (227-250kg).

Electronic Line-Calling Devices

Many systems have been tested or marketed to indicate whether a ball is in or out of play and to indicate whether a serve is good. Some use a series of invisible light rays spanning the court at the lines. Others use a number of circuits in the court pavement which are activated when the ball makes contact. This type of system requires the use of a special ball, with metal particles incorporated in its covering, to activate the circuit. Other systems use radar units which identify and lock onto the tennis ball and determine its point of impact. The location of the ball at any point in flight or on contact with the court surface is done by triangulation of three or more radar units. Radar

systems are portable and can be moved from the site of one tournament to the site of another, but they require a trained technician and several hours to set up. Consult a qualified tennis court designer, consultant or contractor to learn the latest available information on electronic line calling systems.

Scoreboards

Temporary or permanent scoreboards of many types are available. A board 4' (1.219m) by 8' (2.438m) with a place for name cards and numeral hooks or slots will suffice. Relatively inexpensive electronic scoreboards also are available. Individual court score keepers are a nice addition. These attach to the net post and show the names of the players, the set and the score.

Court Numbers

Court numbers are very helpful in assigning courts and in avoiding confusion during tournament play. Weather resistant numbers, compatible with the overall design of the facility and large enough to be easily visible, should be installed on the outside of the fence to identify each court.

Changing Booths

Tournament players often change clothes between sets. A convenient changing booth is appreciated. Combination umpire chair/changing booths are available.

Tennis Court Amenities

Amenities are those items that make a tennis facility comfortable and pleasurable to use. Amenities include items like benches, backboards, drinking fountains, shade shelters, seating, etc.

Backboards and Rebound Nets

A backboard is a useful accessory for solo practice and warmups. In the past, many court owners were hesitant to install backboards because they were noisy. Concrete block and fiberglass backboards, however, are quiet and popular with players.

A backboard 10' (3.048m) - 12' (3.658m) high and 24' (7.315m) long will accommodate two players at the same time. In a separate practice area, there should be fencing or netting on either side and at the top of the backboard to minimize the number of balls going out of the practice area.

It is usually preferable to place a backboard in a separate area to avoid taking up a court for practice. If the backboard must be placed on a court, placing it along the side of an end court, rather than at the back, will minimize the visual distraction during play on that court.

If backboards are to be installed on fences, fence post size and bracing should be appropriate to support the weight and wind load of the structure.

Backboards are constructed of concrete block, wood or fiberglass. Wood backboards are the least expensive and the least durable. In addition, they are noisy. Concrete block is quite durable but expensive, requiring proper footings. Fiberglass is durable and relatively quiet, but also fairly expensive. Fiberglass backboards come in concave and multifaceted versions, which simulate actual play, providing an excellent practice or instruction medium.

Marking a line on a backboard to indicate the height of the net may be helpful.

Rebound nets offer a quiet and inexpensive alternative to backboards. Netting is stretched over a frame and can be set up temporarily if a permanent practice area is not available.

Electronic Backboards

A more recent development in backboards is the electronic backboard. Using embedded electronic sensors and lighted targets in the curved backboard, the electronic backboard permits the player to play against time or against another opponent's score. Training on an electronic backboard blends the high-tech excitement of a computer video game with the visual and motor skill development of traditional tennis drills.

Court Benches

Player seating between courts is helpful. Benches also serve as a place for players to store ball cans, racquet covers, warmups and other belongings. Court benches should be made of suitable materials, resistant to weather and to ultraviolet degradation. Some benches may leave permanent indentations in hard or cushioned court surfaces, so their location and installation should be carefully considered. Benches range in length from 40" (1.016m) to 72" (1.829m); some have backs and others do not. Benches should be placed at the net line and no closer than 12' (3.658m) from the sideline.

Shade Shelters

Shade shelters constructed adjacent to tennis courts (or between courts in a battery) provide an area for players to rest between sets and/or to socialize before, during and after play. They are an important amenity in hot climates, but in all climates, players and spectators appreciate a shaded area to wait for courts, to watch play or to rest between sets.

Shade shelters vary in construction and size, ranging from a simple canvas canopy with a bench to a structure specifically designed to provide seating for players and spectators, a storage area for racquets and other personal items and a place for water fountains or water coolers, trash receptacles, etc.

Shelters constructed on site usually are 6' (1.83m) to 8' (2.43m) in width and 10' (3.04m) to 12' (3.66m) in length. They consist of a framework of wood, steel or aluminum and a canopy made from a durable weather resistance material.

Installation of shade shelters between courts is not recommended where there is less than 24' (7.315m) between adjacent courts. It is recommended that a shelter between two courts be designed with two supports rather than four supports at the corners to reduce the possibility of injury from a player running into the framework. Regardless of design, shade shelter support posts should not be located any closer than 12' (3.658m) from court sidelines to minimize the potential for player injury.

On fast dry/clay courts, if a concrete/brick pad is used, the pad should extend at least six inches past the drip line of the canopy and should be flush with the court surface.

Organizers and Trash Cans

A place for cups, keys and trash is a real convenience to players. As with all court equipment, durability and resistance to weather are important in selecting organizers and trash cans. Such accessories must be attached to net posts or installed a minimum of 12' (3.658m) from the sidelines. They should be anchored firmly.

Drinking Fountains

A source of drinking water should be located adjacent to tennis courts. As an added feature, a faucet for rinsing hands and face will be appreciated by players. The pipe supplying the drinking fountain should be buried at least 48" (1.219m) deep to prevent the pavement from heating the water during the summer months. In addition, as with all tennis facility components, the ADA requires that all drinking fountains be fully accessible.

Where a permanent water connection is not available, portable water cooler stands may be used. Cooler stands may include a cup-holder and trash can, as well. A refrigerator also is a welcome addition.

Outlets

Convenient 110V outlets are recommended for all tennis courts. At least one duplex outlet per court is desirable for ball machines or maintenance equipment.

Ball Machines

Ball machines are used for instruction or for practice. Many models require a 110V outlet, although there are now a few battery powered models available. There is considerable variety in ball machines, some being quite basic and others being programmable for speed, spin, trajectory, frequency and shot location. Two basic operating principles are used — air propelled machines and mechanical machines, which use spinning wheels to project balls, much like pitching machines. Ball machines vary widely in ball capacity. Some machines have remote control devices.

Ball Retrievers

Several types of ball retrievers are available. These devices make it possible to pick up tennis balls without bending over and are a great energy and time saver for instruction and practice. Ball retrievers include metal tubes, wire baskets, cloth baskets and sweepers. For courts used frequently for practice and instruction, an automated ball retrieval system may be installed. Such a system returns balls in much the same way bowling balls are returned; the balls roll into an alley or trough equipped with a conveyor belt.

Storage Areas

It is very convenient to have lockable storage for ball machines, court maintenance and instructional equipment nearby. In planning storage, consider size, location and access.

Spectator Seating

Spectator seating should be placed a minimum of 15' (4.572m) outside the side playing lines and 24' (7.315m) behind the baselines. A canopy over the seating area will make watching play far more comfortable for spectators. Where stadium-type seating is installed, drainage is an important consideration.

Shoe Cleaners

On clay and fast dry courts, an important accessory is a shoe cleaner. Placed near the gate and/or near the entrance to the clubhouse or pro shop, a shoe cleaner helps prevent players from tracking loose material onto paths or indoors. A shoe cleaner is particularly important in facilities featuring multiple surfaces since fast dry or clay material tracked onto hard courts may cause wear to the color coatings.

Court Covers

For court owners who want to afford some protection to their courts in the off season, tarp-like court covers are available.

Security and Safety

Security is a function of lighting and of limiting access to courts. Where tennis facilities will be used for tournaments, fencing issues become important. Fencing may help to offer tournament player security and may help to prevent unauthorized persons from entering.

A telephone or intercom at each court provides a great convenience, as well as an important line of communication in the event of player injury.

Other desirable amenities include clocks, nearby restrooms, lockers, changing facilities and first aid supplies.

Tennis Courts

A Construction and Maintenance Manual

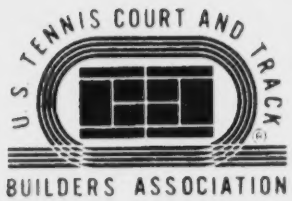

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Table of Contents

Foreword by Stan Smith vi

Introduction vii

Author's Acknowledgments ix

How This Book Came to Be xi

About the USTC&TBA

The U. S. Tennis Court and Track Builders Association xiii
U.S. Tennis Court and Track Builders Association Officers and Directors 1997 - 1998 xiv
Certified Tennis Court Builders xv
Membership Information xvi
Publications xvii
USTC&TBA Awards xviii

About the USTA

United States Tennis Association xxi
United States Tennis Association Officers and Directors 1997-1998 xxii
United States Tennis Association Technical Committee xxiii
USTA Sections xxiv
Membership Information xxv
Publications xxvi
USTA Awards xxvii

I. Getting Started 1

The Planning Team 1
Design/Build Projects 2
Design/Bid Projects 2
Designers and Consultants 2
Planning 3
Budgeting 4

II. Planning and Design Considerations 7

Playing by the Rules 7
Suggestions on How to Establish Playing Lines 9
Number of Courts 11
Site Requirements 13
Size 14
Soil Conditions 14
Drainage 23
Site Grading 28
Trees and Other Vegetation 32
Site Planning 32
Impact of Region, Geography and Location 40

Types of Projects 41
Designing for Player Preferences and Special Populations 47
The Ideal Tennis Court 49

III. The Construction Process 53
Permits, Codes, Authorities 53
Selecting a Tennis Court Designer or Consultant 53
Specifications 54
Bid Process 55
Contract Documents 55
Choosing a Contractor 55
Overview of Construction 57
Construction Timetable 58

IV. Choosing a Surface 61
Drafting Pavement and Surface Specifications 61
Classifying Tennis Courts 62
Soft Courts 63
Clay or Fast Dry Courts 65
Grass Courts 70
Sand-Filled Synthetic Turf 72
Hard Courts 74
Asphalt Courts 74
Concrete Courts 75
Color Coating Systems for Asphalt and Concrete Courts 82
Cushioned Surfaces 85
Modular Surfacing Systems 85
Sheet or Roll Goods 86
Other Surfaces in Less Common Use in the U.S. 86

V. Accessories and Amenities 89
Tennis Court Accessories 89
Net Posts 89
Nets 90
Center Straps and Anchors 94
Lighting 94
Fencing 107
Windscreens 114
Divider Nets 115
Competition Accessories 116
Tennis Court Amenities 117

VI. Indoor Tennis 121
Court Enclosures 121
Padding 126
Ceiling Systems and Insulation 126
HVAC Systems 126
Indoor Lighting 129

Court Surfaces 132
Perimeter Curtains 133
Divider Nets 133
Tennis in an Athletic or Fitness Club 134

VII. Care and Maintenance 135
General Maintenance 135
Hard Court Maintenance 138
Fast Dry Court Maintenance 140
Clay Court Maintenance 144
Grass Court Maintenance 149
Sand-Filled Turf Court Maintenance 152
Net Maintenance 153
Net Post Maintenance 154
Lighting Maintenance 156
Windscreen Maintenance 156
Landscape Maintenance 160

VIII. Repair, Reconstruction and Renovation 161
Recoating Asphalt and Concrete Tennis Courts 162
Repair of Asphalt Tennis Courts 162
Repair of Concrete Tennis Courts 167
Reconstruction and Conversion 169
Drainage 169
Renovation 171

IX. Sources of Information 173
Reference Books 173
Trade Publications 173
Trade Associations 175
Associations of Design Professionals 177
Governing Bodies 178

Glossary 179

Color Photo Credits 186

INDEX OF DRAWINGS
Establishing Playing Lines 10
Tennis Court Playing Line Layout Plan - PLINES 15
Typical Single Court Layout Plans - Layout-1 16
Typical Stadium Court Layout Plans - Stadium 17
Typical 2 Court Battery Layouts - Layout-2 18
Typical 3 Court Battery Layouts - Layout-3 19
Typical 4 Court Battery Layouts - Layout-4 20
Typical 4 Court Battery Layout - Layout-5 21
Surface Drainage at Court Edges - Drain-3 24
Subsurface Drainage at Court Edges - Drain-4 26

Rockless or Geocomposite Drain at Court Edge - Drain-5 27
Typical Drainage Patterns for One Tennis Court - Drain-1 30
Typical Drainage Patterns for Multiple Tennis Courts - Drain-2 31
Court Construction on a Sloped Site - Retain-1 33
Typical Retaining Walls at Up-Hill Side of Court Edge - Retain-2 34
Typical Retaining Walls at Up-Hill Side of Court (Set Back) - Retain-3 35
Typical Retaining Walls at Down-Hill Side of Court Edge - Retain-4 36
Tennis Court Orientation 38
Dividing a Regulation Tennis Court Into Four Short Tennis Courts 50
A Single Short Tennis Court 50
Typical Court Construction Time Tables 59
Chart Comparing Representative Tennis Court Surfaces 64
Typical Natural Clay Court Section - Clay-1 67
Typical Fast Dry Court Section - FDRY-1 68
Typical Fast Dry Court Edging - Edge-3 69
Typical Section Grass Court - Grass-1 71
Typical Sand-Filled Turf Court Sections-Sand-1 73
Typical Asphalt Court Sections - Asph-1 76
Section Extended Apron At Asphalt Court Edge - Edge-2 77
Typical Asphalt Court Edging with Brick or Concrete Block - Edge-1 78
Typical Sections Reinforced Concrete Court Pavement - Conc-1 80
Typical Sections Post-Tensioned Concrete Court Pavement - PTCONC 81
Tennis Net Post Footing - NETPOST 91
Typical Tennis Net Elevations - Net-Elev 92
Tennis Net Center Strap Anchor - CSTRAP 95
Recommended Illumination for Outdoor Tennis Facilities 97
Light Meter Reading Location Diagram - L-METER 98
Comparative Characteristics of Light Sources for General Lighting Purposes 101
Typical Court Lighting Sections - Light-1 103
Typical Court Lighting - High Mast - Light-HM 105
Typical Court Lighting - Low Mast - Light-LM 106
Typical Side Fence Elevations - Fence - ELV 108
Typical Fence Plans - Square Corner - Fence - SQ 109
Typical Fence Plans - Cut Corner - Fence - Cut 111
Typical Sections Fence Wood Posts - Fpost - 1 113
Typical Fabric Frame Court Building Section 125
Typical Air Supported Structure Court Building Section - Indoor-3 125
Typical Indoor Tennis Building Plan - Indoor-1 127
Typical Wide Span Court Building Section 128
Typical Long Bay Court Building Section - Indoor-2 128
Recommended Illumination for Indoor Tennis Facilities 130
Light Meter Reading Location Diagram - L-Meter 131
Tennis Industry Magazine's Annual Maintenance Planner 136-137
Typical Surface Irrigation System Layout Plans - IRRIG 146
Schematic Diagram of Fast Dry Court Subsurface Irrigation System - Irrig2 147
Typical Grass Court Layout and Rotation Pattern - Grass-2 150
Typical Net Lacing Diagram - Net-ELV2 155
Windscreen Measurement Diagram - WSCRN - 1 158
Conversion - Hard Court to Fast Dry - Conver-1 170

INDEX OF ADVERTISERS

Ball Products ..... reverse chapter title page: Accessories and Amenities
Courtsider Sports 88
Deco Surfacing ..... inside back cover
Global Consult Group ..... reverse chapter title page: About USTA
Har-Tru 187
Indoor Courts ..... reverse chapter title page: Indoor Tennis
ISP Mineral Products ..... reverse chapter title page: Getting Started
J.A. Cissel 188
Latexite ..... reverse chapter title page: Repair and Reconstruction
Lee Tennis ..... reverse chapter title page: Planning & Design
Malott Peterson ..... reverse chapter title page: The Construction Process
Nova Sports ..... reverse chapter title page: Choosing a Surface
Pavement Depot ..... reverse chapter title page: Care and Maintenance
Plexipave ..... inside front cover
SealMaster ..... reverse chapter title page: Sources of Information
Welch Tennis ..... reverse chapter title page: About USTC/TBA

Foreword

by Stan Smith

I was very pleased to review this book, *Tennis Courts: A Construction and Maintenance Manual*. Such a publication has been needed for a long time. All too often in the great sport of tennis, the design and construction of tennis facilities is an afterthought. As a result, owners find themselves with courts that all too soon show the effects of negligible planning and shoddy construction. That leads to a decline in player interest. Good facilities, in turn, translate into happy players who want to spend more time on the court.

This manual is a comprehensive guide to help individuals educate themselves about the many aspects involved in building and caring for a quality facility. Maybe the average consumer will never need to know all this information, but it will help him or her to ask the right questions when undertaking the project and, later, when hiring the right people to do the job properly. In addition, this book will be useful for designers, contractors and facility managers who will turn to it repeatedly for information on design, construction, maintenance and repair.

As I read through the book, I particularly enjoyed certain sections. I recommend the section on planning and design considerations because it is at that stage that we can prevent the need to redo the facility within a few years. Many court problems occur because of unsuitable soil and poor drainage — items which could have been identified and cured during site investigation and site preparation. Problems like these, if not caught, can come back to haunt the facility soon after completion, and will continue to plague the project for the rest of its existence. The section on care and maintenance gives some valuable tips on avoiding large problems by doing routine upkeep. With consistent professional care, any court will be a real pleasure on which to play.

Thoroughness in planning, care in workmanship, quality in materials and ongoing care — these are the things that make good tennis courts, and this is the book that explains how they all work together. This manual will be a big help to anyone involved in the development, construction, maintenance and repair of any tennis facility. I recommend it to those who want the job done right.

Stan Smith

138

Introduction

The purpose of this book is to promote the quality construction, maintenance and repair of tennis facilities by providing information to facility owners, managers, pros, builders, architects and engineers. Since no two tennis projects are alike, in most cases, this book cannot provide definitive answers. Rather, it is designed to explain the choices and the rationales for various choices. This will allow the owner to ask important questions and to make reasoned decisions. Asking questions is not only smart, it is essential. The investment of time and energy in learning about tennis facilities can yield a huge return in terms of a quality facility and in the hours of enjoyment that will be derived from it. The USTC&TBA and the USTA are committed to providing information to assist facility owners and managers in making informed choices in order to promote the construction of quality tennis facilities.

A few words about the content of this book:

Dimensional Notation

Most dimensions are expressed in both English and metric units. Since the majority of the users of this book will be persons familiar with the English system, the English units are written first followed by the metric units written in parentheses. Metric dimensional equivalents are converted as accurately as possible in accordance with the following formulas:

English		Metric
1"	=	0.02540 meters
1'	=	0.30481 meters

Metric equivalents for specific items such as tennis court playing lines, layouts and net heights must be converted as accurately as possible to conform to the rules of tennis. (See Chapter III.) These are called hard conversions. In practice, however, other conversions are routinely adapted. For example, this book recommends a 24' separation between courts in a common enclosure, which is converted by the formula to 7.315m. For ease of construction, that dimension might be rounded to 7.5m or 8m or even 7m (which, of course, is slightly less than the recommended dimension). In other words, the nearest appropriate metric dimension is chosen — appropriate in terms of feasibility of construction, design intention, etc. These are called soft conversions. For purposes of this book, we have made hard conversions; it is expected that the owner, designer or contractor will choose an appropriate soft conversion, except where hard conversions are required as described above.

A few more conventions regarding the metric system. The preferred units for construction are the millimeter (mm) and the meter (m). Generally, centimeters (cm) are not used. Millimeters are always expressed as whole numbers, while meters are routinely expressed as decimal numbers. Fractions are not used in the metric system. When linear dimensions are used to describe an area, such as 40mm x 90mm, the width is listed first and the length second. Finally, there are no nominal sizes in the metric system; a 2" x 4" piece of lumber is 38mm x 89 mm in metric terms.

Slope Notation

Slopes less than 1% are typically noted in the form of inches per feet written as 1" in "x" feet. Slopes of 1% and over typically are noted as straight percentages. In order to ensure clarity, it is best to use either the inches per feet or the percentage notation system in combination with a specific ratio (expressed as vertical rise "x" to horizontal run "y" or "x:y"). Expression of slope with a ratio can be easily understood by engineers, architects, landscape architects and/or contractors whether they are using the English or metric systems. Below are some typical slope conversions which are most frequently used in the design and construction of tennis courts:

Inches per Feet	Percentage	Ratio	Use
1" in 60'	0.14%	1:720	Min. slope of a clay or fast dry court with subsurface irrigation
1" in 30'	0.28%	1:360	Max. slope of a clay or fast dry court with subsurface irrigation; min. slope of a clay or fast dry court with above ground irrigation
1" in 24'	0.35%	1:288	Max. slope of a clay or fast dry court with above ground irrigation
1" in 15'	0.56%	1:180	Min. slope of a hard court*
1" in 10'	0.83%	1:120	Recommended slope of a hard court
1" in 8.33'	1%	1:100	Max. slope of a hard court; min. slope of a non-court pavement; recommended slope of a grass court
1" in 1'	8%	1:12	Max. slope of a disability ramp

* Minimum slope of sanctioned tournament facilities. Not recommended for other types of construction due to cost and expertise required. Requires laser grading.

Disclaimer

The drawings for this book are intended to provide clarification of the design and construction concepts discussed in the text. These illustrations are meant to represent generic solutions typically used in the design and construction of tennis courts today. Each drawing represents only a single option to address the needs described in the text. In every case, there are other ways to achieve the design construction intent. In addition, readers of this book are cautioned that site conditions can vary widely. Local climates, construction methods, availability of materials and site engineering requirements make the development of construction details for use everywhere virtually impossible. While every effort has been made to ensure the accuracy of the drawings, neither the USTA nor the USTC&TBA is responsible for any errors or omissions.

The recommendations in this book are suggestions for use by architects, engineers, contractors and owners. Except where they refer to the rules of tennis, these guidelines provide options, explanations or illustrations of typical generic solutions to construction issues. Parties not experienced in tennis court construction are advised to consult a qualified contractor and/or design professional. Due to the differences in design intent, climates and construction sites, each project is different. The USTC&TBA and the USTA make no representations regarding the suitability of a particular design or decision to a specific project.

Readers are urged to consult with qualified and experienced design professionals and/or contractors before deciding upon the specific design, materials and construction methods to be utilized in proposed tennis court facilities.

AUTHOR'S ACKNOWLEDGMENTS

Carol Shaner

As we prepared the publication of the *USTC&TBA Tennis Facilities Construction and Maintenance Manual*, I wrote the following:

> While most of the words came from me, in truth, this book is the work of the entire membership of the U. S. Tennis Court and Track Builders Association. The members shared unselfishly the knowledge acquired through their years of experience. They patiently explained those things I did not understand. They offered their articles, their conference presentations, their drawings and their photographs for the benefit of other members of the industry and, mostly, for the benefit of owners and users of the facilities they build.
>
> This book was reviewed by many people at all stages of its development; their comments and suggestions are very much a part of the end product.
>
> Special thanks to Andrew Lavallee, RLA, who performed a technical review on the finished text and who provided most of the drawings, to Dick Funkhouser and Martin Wylde who chaired the committee overseeing the project at various stages of its development, and to Gordy Pierce, CTCB, Sheldon Westervelt, PE and Martin Wylde, who served as technical editors.
>
> I am indebted to the following individuals who spent many hours reviewing the text, educating me and making useful suggestions:
>
> John Bardeen
> Burnham Beard CTCB
> Peggy Welch Beard CTCB
> Jerry Gray CTCB
> Lex Kessler
> Ron Lewis, PE
> David Marsden CTCB
> David Moore CTCB
> Gordon Pierce CTCB
> Kevin Smith CTCB
> Sheldon Westervelt, PE
> Martin Wylde
>
> Others who contributed include: Tony Campbell, Will Ferguson CTCB, Bruce Frasure, Dick Funkhouser, Richard Joyce, Joan Koza, Matt Lanin CTCB, Warren Mackenzie, Art Mayne, Carl Paylor CTCB, Roger Pocta, PE, Bill Spisak and Steve Wright.
>
> Thanks to Rob Werner who helped to decide which photos were needed to illustrate the text, and to David Moore CTCB, Gordy Pierce CTCB, Sheldon Westervelt, PE and others who supplied photos.
>
> Thanks to Tom Brennan, Montage Productions, for graphic design/typesetting.
>
> And, finally, many thanks to Mary Helen Sprecher and Judi Mellendick, who proofed and edited both the drafts and the final work.

This joint book is still very much a product of that effort and all those mentioned above can take much of the credit for it.

This project also is indebted to the vision of those who conceived and produced twelve editions of the USTA's *Tennis Courts* from 1968 through 1992. Alfred S. Alschuler, Jr., a USTC&TBA life member and long time USTA volunteer, edited the book for many years with input from the members of the Technical Committee of the USTA. Harold Zimman

of H.O. Zimman was its publisher. Sheldon Westervelt, PE served as Technical Editor for the revision to have been produced in 1998. That book was set aside in favor of this joint work. Portions of that edition of *Tennis Courts* were incorporated into this publication.

In bringing together the two works, a Joint Editorial Board not only decided which material from *Tennis Courts* was to be added to *The Tennis Facilities Construction and Maintenance Manual* and edited the combined manuscript, but made all of the financial and operational decisions necessary to produce the product you hold in your hands. This manual is their work. They are:

Peggy Beard CTCB	Sheldon Westervelt PE
Gordy Pierce CTCB	Martin Wylde

USTA Technical Committee Vice-Chairman Lex Kessler, a former USTC&TBA Board member, conceived the idea of putting the two books together and spearheaded efforts to make it happen. USTC&TBA's legal counsel David H. Pettit and USTA's Technical Committee Chairman, Steven K. Champlin, also an attorney, patiently worked out the details of the agreement for this joint book, a fine example of two organizations, the USTA and the USTC&TBA, partnering in the interest of tennis and the tennis playing public.

Judy Burns, JB Graphics in Fallston, MD, designed the cover and produced additional graphics for the combined edition. Tom O'Brien of Accucopy in Greenville, NC, patiently explained the mysteries of book production to me and I will forever be indebted.

USTA staffers who assisted with this effort included David E. Schobel, Director of Adult Tennis, who serves as liaison to the USTA Technical Committee and Rick Rennert and Edna Gabler of the USTA Publishing Department.

Sincerest thanks to all those named, without whom I couldn't have produced a single page.

HOW THIS BOOK CAME TO BE

This book is the joint effort of the United States Tennis Court and Track Builders Association (USTC&TBA), and the United States Tennis Association (USTA). It represents the two organizations' dedication and commitment to the game of tennis. Specifically, it reflects an awareness on the part both organizations that optimum performance and optimum enjoyment of the game of tennis is dependent upon having a safe, well-equipped, attractive and well-constructed facility on which to play. This book, which utilizes the in-depth body of knowledge offered by members of both organizations, aims to help provide the information owners need to build and maintain such facilities.

The U.S. Tennis Court and Track Builders Association, founded in 1965, has long been considered the authority on standards for tennis court construction. The history of the USTA, meanwhile, is deeply rooted in its development of rules and regulations for the playing public as well as in the implementation of tennis programs. The USTC&TBA publishes construction guidelines, as well as several brochures and books designed to help guide consumers step by step through the complicated maze of selecting a contractor, deciding upon a surface and finding a suitable location for a tennis court. The USTA offers a plethora of publications that not only assist players in becoming familiar with the rules of tennis, but assist others with the setup and running of tournaments, as well as other tennis-related events.

Beginning in 1968, the USTA published its first edition of a book entitled *Tennis Courts* as a service to its members and the public. This publication was immediately embraced by the public. Subsequent editions, published every two years, included the guideline specifications of the USTC&TBA, adding even more technical depth to an already excellent publication. The USTA's Technical Committee worked on the book, refining it each year, and adding the information consumers requested. Year after year, *Tennis Courts* was a buyer favorite, offered by both the USTC&TBA and the USTA.

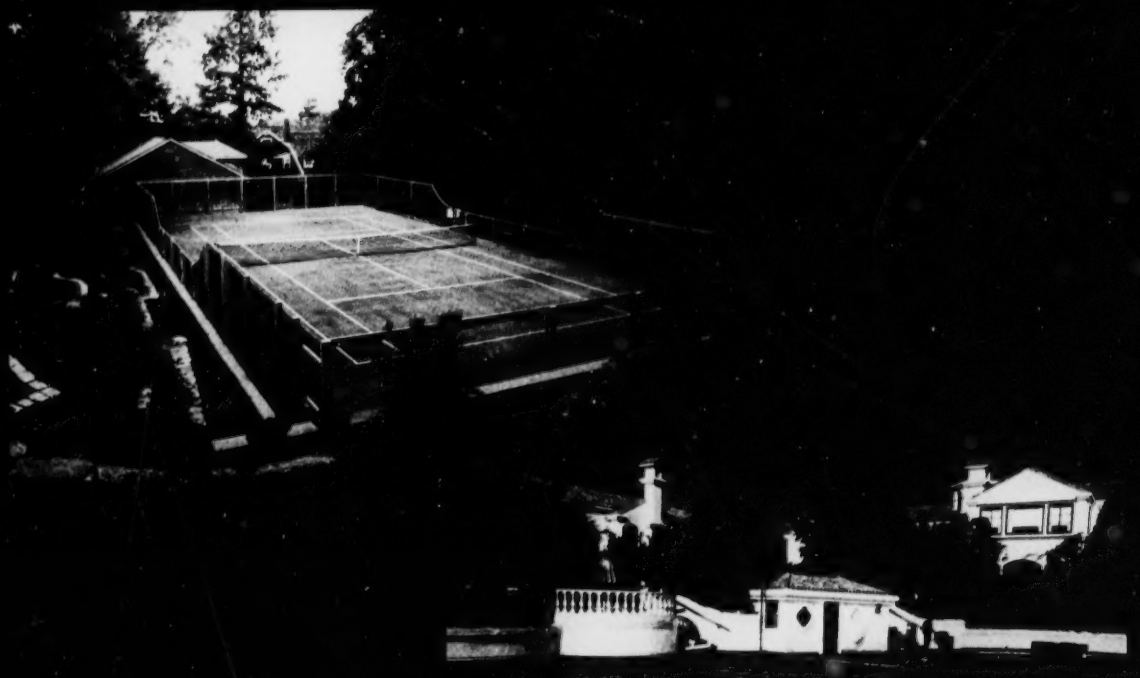
In 1992, the U.S. Tennis Court & Track Builders Association found itself addressing the need for a new type of tennis book — one which would contain more technical detail, including that relating to design, landscaping, site selection, the construction process, court maintenance and repair, specific information relating to accessories and amenities and so forth. In the opinion of the USTC&TBA, the game of tennis was changing, influenced by new technologies, and consumers needed more information to make informed decisions regarding the construction and care of tennis facilities.

With this thought in mind, the USTC&TBA commissioned its Executive Vice President, Carol Shaner, to write *The Tennis Facilities Construction and Maintenance Manual*. With the aid of numerous volunteers who contributed time, expertise and materials, the book became a reality in 1997, and immediately became USTC&TBA's most popular publication to date.

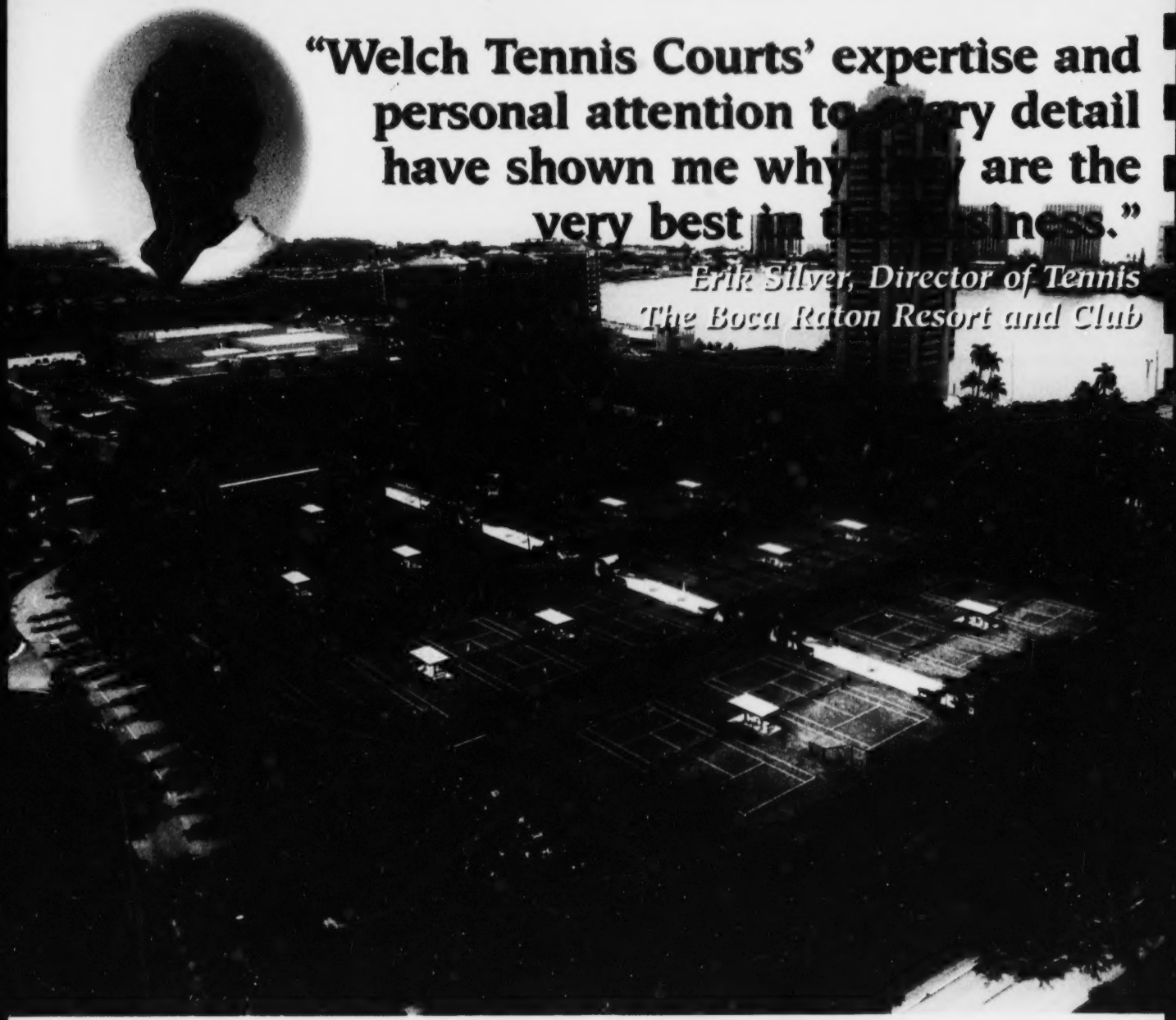
At approximately the same time, the USTA had been working on a new edition of *Tennis Courts*. After reading through the USTC&TBA's new book, however, it became clear to the USTA that there was an opportunity for a cooperative venture. And so, the process of compiling the information of two excellent books began.

Approximately one year after this effort began, we are pleased to offer *Tennis Courts: A Construction and Maintenance Manual*. It is our hope that you will find it not merely an informative and excellent resource for your current project, but a reference you will reach for in the future to answer the questions that invariably come up. Rules, regulations, design, landscaping, construction, safety, courts for various forms of tennis play, equipment and more —it's all in here, thanks to the combined efforts of two excellent organizations totally devoted to the growth and love of the sport of tennis.

About the USTC&TBA



U.S. TENNIS COURT AND TRACK BUILDERS ASSOCIATION



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The U. S. Tennis Court and Track Builders Association

The United States Tennis Court & Track Builders Association (USTC&TBA) is a national organization for builders, designers and suppliers of materials for tennis courts and running tracks. It is recognized as a centralized source for technical information, including specifications, on tennis courts and tracks.

USTC&TBA was founded in 1965 by a group of contractors who recognized the need for an organization that could help them address their mutual problems, set industry standards, and keep them informed on issues pertinent to their business. Today, with nearly 300 members, the USTC&TBA supports the drive for excellence in the industry by maintaining that commitment to quality tennis court and track construction.

Headquartered in Maryland, the USTC&TBA continues to take steps to raise the professional standards of the industry in order to insure that consumers receive services of the highest quality. As part of its work to achieve this goal, the Association sponsors a certification program which permits experienced builders to demonstrate their competency by completing an examination on all areas of tennis court or running track construction. In addition, USTC&TBA offers a newly redesigned awards program to recognize excellence in tennis and track facility design, construction and renovation.

Another priority is education of the industry. The Association sponsors informative meetings featuring a trade show, along with sessions on both basic topics and advanced or newly developed technologies. USTC&TBA publishes newsletters, guideline specifications and other publications useful to designers, builders, owners and operators.

USTC&TBA's educational efforts don't stop with the industry, though. The Association knows that it is the well-informed consumer who is more likely to make a decision that will result in a facility he or she can enjoy for years to come. USTC&TBA publishes a *Buyer's Guide for Tennis Court Construction*, as well as a *Buyer's Guide for Running Track Construction*, which are available to anyone contemplating a project. These booklets provide information on the process of selecting a site, choosing a contractor, identifying a surface and so forth. More detailed publications including *Construction Guidelines* and technical manuals such as this one also are available. Finally, the Association offers a directory of members at no charge; the directory allows consumers to locate design professionals, builders and material suppliers, as well as consultants, trade publications and other industry resources. A publications order form, as well as many free publications, are available on the Association's web site at ustctba.com.

Like its publications, the USTC&TBA is a resource not only for the professionals who design, build and supply materials for top-flight sports facilities, but for the owners, operators, players and others who enjoy them. The members of the Association recognize that the way to continue interest in the sports of tennis and track is to provide an environment which is conducive to enjoyment and/or performance.

U.S. Tennis Court and Track Builders Association
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1997-1998

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Certified Tennis Court Builders

The Certified Tennis Court Builder Program was developed by the USTC&TBA to help raise professional standards and to improve the practice of tennis court construction. The following is a list of people who, by passing a comprehensive examination on tennis court construction and maintenance, and by fulfilling prescribed standards of experience, have demonstrated a high level of knowledge in tennis court construction.

David W. Baird CTCB
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Welch Tennis Courts, Inc.
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Bruce Mahler CTCB
Boston Tennis Court Constr.
Hanover, MA

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Boston Tennis Court Constr.
Hanover, MA

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West Valley City, UT

Gerald Perry CTCB
Gerald Perry Tennis Courts
Springfield, MO

Gordy Pierce CTCB
Cape & Island Tennis & Track
Pocasset, MA

Robert Reali CTCB
Cape & Island Tennis & Track
Pocasset, MA

Donna Sierks CTB, CTCB
Southwest Recreational Ind.
Denver, CO

Kevin F. Smith CTCB
SMITH-Wheeler, Inc.
Toledo, OH

Darryl Snyder CTCB
Southwest Recreational Ind.
Wichita, KS

Mike Vinton CTCB
Vasco Asphalt Company
Massillon, OH

Gerry Wright CTCB
Court One
Raleigh, NC

Steve Wright CTCB
Indoor Courts of America
Olathe, KS

*Note: This list is correct at the time of printing. For an updated list of certified builders, call USTC&TBA at 410-418-4800.

U.S. TENNIS COURT & TRACK BUILDERS ASSOCIATION

3525 Ellicott Mills Drive,
Suite N.Ellicott City, MD 21043-4547
Phone: 410-418-4875 Fax: 410-418-4805

Application For Membership

Legal Description. A non-profit, non-stock corporation chartered by the State of Delaware on April 1, 1965.

Please enroll me as a member in the following category:

_____ **Builder:** Any individual, partnership or corporation which for a period of two years has been actively engaged in the building or surfacing of tennis courts, running tracks or other athletic or recreational surfaces. Any individual, partnership or corporation that assumes overall responsibility for a construction contract regardless of what portion of the construction, if any, that company actually undertakes.
Annual Dues — $595.00

_____ **Associate:** Any individual, partnership or corporation which for a period of two years has been actively engaged in the manufacture for resale or distribution at wholesale of materials, hardware or accessories used in the construction of tennis courts, running tracks or other athletic or recreational surfaces.
Annual Dues — $635.00

_____ **Affiliate:** Any individual, partnership or corporation which for a period of two years has been engaged in the installation of products that are related to tennis courts, running tracks or other athletic or recreational surfaces, not including Builder Members. Examples include fence erectors, lighting contractors, curb formers and stripers.
Annual Dues — $635.00

_____ **Professional Member:** Any individual, partnership or corporation which, though not coming within any of the foregoing classifications, has professional qualifications pertaining thereto and is a licensed design professional or is engaged in the business of rendering professional design or consulting services on a fee basis in connection with the construction of tennis courts, running tracks or other athletic or recreational surfaces. Professional Members shall not represent, market or sell any product.
Annual Dues — $335.00

_____ **Provisional Member:** Any individual, partnership or corporation which would otherwise be eligible to be a Builder, Associate or Affiliate Member of the Association, but which does not satisfy the two-year business requirement. Provisional members shall become full-time members in the appropriate category once the two year requirement is passed; and until then, cannot vote, hold office or display the USTC&TBA logo.
Annual Dues — $295.00

_____ **Ancillary Member:** Other parties, which though not coming in any of the foregoing categories, are interested in helping to fulfill the purposes of the Association. Trade magazines and non-profit organizations are examples of Ancillary Members.
Annual Dues — $310.00

Note: Applicants outside the continental U.S. (except Canada and Mexico) must add $40.00 to stated dues amounts to cover increased postage.

Applications should be mailed to: **3525 Ellicott Mills Drive, Suite N, Ellicott City, MD 21043-4547**

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Additional Representatives **(3 maximum)**
1. _____ Position _____
2. _____ Position _____
3. _____ Position _____
Briefly describe your organization (25 words maximum) _____
_____
_____
_____
_____
_____

If applying for Builder, Associate or Affiliate membership, please list the names of current members, industry colleagues, customers or materials suppliers who can verify that your company has been in business for two years, and otherwise meets the definition of the membership category.

Company Name: _____
Contact Name: _____
Address: _____
City: _____ State: _____ Zip: _____

Company Name: _____
Contact Name: _____
Address: _____
City: _____ State: _____ Zip: _____

Company Name: _____
Contact Name: _____
Address: _____
City: _____ State: _____ Zip: _____

Affirmation: I agree to abide by the Bylaws and Code of Ethics of the U.S. Tennis Court & Track Builders Association and all lawful amendments thereto. (Copies available upon request)

Date: _____ Signature: _____

Dues check should accompany this application. Application will not be processed without dues payment. Dues payments are not tax deductible as charitable contributions; however, they may be tax deductible as ordinary and necessary business expenses. Please consult your tax advisor.

USTC&TBA MARKETPLACE

_____ ***USTC&TBA Directory***
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$19.95 ea.

_____ Manual of Clay Court Maintenance
$9.50 ea.

_____ Buyer's Guide for Tennis Court Construction
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_____ Buyer's Guide for Running Track Construction
$3.00 ea.

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_____ Tennis Court Facilities Construction & Maintenance Manual
$39.95

USTC&TBA Order Form

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Company: _____

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City/State/Province: _____ ZIP: _____

Country: (if not USA) _____

Telephone No.: _____

Prepayment is required with all orders; USTC&TBA does not invoice or accept purchase orders for merchandise. For bulk publication orders, discounts apply: 15% off orders of 5 or more copies of same publication; 25% off orders of 25 copies or more of same publication. Postage and handling charges cover order processing, packaging & regular ground service delivery costs within the continental U.S. International shipments and those going outside the continental U.S. (including Alaska and Hawaii) must be sent via air service and are subject to higher shipping costs. The customer is responsible for all applicable duty and customs charges for international shipments. For overnight shipping costs, air shipping or other questions about your order, please call (410) 418-4875 for rate information. Any item(s) out of stock at the time of order will be sent upon availability.

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NOTE TO THOSE USING CREDIT CARDS: Charges from USTC&TBA will appear on your monthly statement as "Association Headquarters." Please keep this in mind when paying your charge card bills.

USTC&TBA Awards

The USTC&TBA awards program has the goal of promoting the highest standards of construction excellence. Any USTC&TBA members contributing to the design and/or construction of an outstanding project or facility are encouraged to submit an application for one of several industry awards.

Originally, the Association offered three awards: the Harry Humphries Award in recogntion of technical excellence, the Russell B. Goddard Award in recogntion of aesthetic excellence, and the Industry Merit Award presented to an individual who has made an outstanding contribution to the Association and to the industry.

In 1995, the USTC&TBA Board of Directors revised its awards program. The USTC&TBA now presents Outstanding Tennis and Track Facility Awards in recognition of both technical and aesthetic achievements in the construction and/or renovation of tennis and track venues.

1997

Outstanding Tennis Facility Awards

Private Residence
Gladwyne, PA
Pro-Sport Construction, Inc.

Private Residence
Los Angeles, CA
Zaino Tennis Courts, Inc.

Mar-a-Lago Club
Palm Beach, FL
Fast-Dry Courts, Inc.

Fairfax Racquet Club
Fairfax, VA
Indoor Courts of America, Inc.

Boca Raton Resort & Club
Boca Raton, FL
Welch Tennis Courts, Inc.

Private Residence
Duxbury, MA
Boston Tennis Court Construction Co.

Tellico Village Property Owners' Association Loudon, TN
Empire Recreational Surfaces

Private Residence
California Products Corp.
Cambridge, MA

The Nidom Resort
Hokaido, Japan
Global Consult/Global Consult Japan

Snyder Tennis Center, University of Virginia, Charlottesville, VA
Global Consult Group

Private Residence
Branson, MO
Gerald Perry Tennis Co.

Richland Tennis Center
North Richland Hills, TX
Schrickel, Rollins & Associates, Inc.

Industry Merit Award

Jerry L. Gray CTCB

1996

Outstanding Tennis Facility Awards

Boca West Club
Boca Raton, FL
Fast-Dry Courts, Inc.

Kensington Golf and Country Club
Naples, FL
Welch Tennis Courts, Inc.

McCormack-Nagelson Tennis Center
College of William & Mary
Williamsburg, VA
Global Consult Group, Inc.

Premier Athletic Club
Montrose, NY
Indoor Courts of America

Private Residence
Santa Ana, CA
Zaino Tennis Courts, Inc.

Sant'Agnese Tennis Club
Rome, Italy
Global Consult Group, Inc.

The Sonoran Clubhouse
Scottsdale, AZ
Global Consult Group, Inc.

The Tennis Center at Crandon Park
Key Biscayne, FL
Rossetti Associates Architects

The Tennis Center of Coral Springs
Coral Springs, FL
Global Consult Group, Inc.

Private Residence
Scottsdale, AZ
Global Consult Group, Inc.

1994

Russell B. Goddard Award

Greiner, Inc.

Harry Humphries Award

Welch Tennis Courts, Inc.

1993

Russell B. Goddard Award

Welch Tennis Courts, Inc.

Harry Humphries Award

Dalton Enterprises, Inc.

1992

Russell B. Goddard Award

Greiner, Inc.

Industry Merit Award

Sheldon Westervelt, PE

1991

Harry Humphries Award

Indoor Courts of America

1990

Russell B. Goddard Award

Global Consult Group

Harry Humphries Award

Pacific Tennis Courts

1989

Russell B. Goddard Award

American Recreational Industries,
A Div. of Basil D. Rissolo Co.

Harry Humphries Award

Pacific Tennis Courts
Vermont Tennis Courts

About the USTA

Global Consult Group

Stan Smith Design

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DESIGN
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A Higher Standard

of Tennis Facility Design

Kimball

L. Robert Kimball & Associates

615 W. Highland Avenue
Ebensburg, PA 15931
Telephone: 814-472-7700

www.lrkimball.com

United States Tennis Association

The United States Tennis Association is a volunteer organization, founded in 1881 to establish and maintain the rule of play, as well as high standards of amateurism and good sportsmanship. As decreed by the Amateur Sports Act of 1978, the USTA is the national governing body for tennis. This designation requires the USTA to have open membership and to sanction events open to all athletes in the United States, regardless of race, creed, color or national origin. The USTA also encourages, through tennis, the development of health, character and responsible citizenship. All are standing provisions in the constitution and bylaws of the USTA.

The US Open is the event with which many people associate the USTA. Indeed, the US Open is a dynamic force. But it is perhaps best thought of as a tool in the USTA's mission to promote and develop tennis as a means of healthful recreation and physical fitness in the United States. In addition to promoting tennis via the US Open, the USTA works year-round to develop the sport by administering programs that, in essence, constitute much of the country's tennis activity: the school programs that introduce children to the sport, the junior tennis programs at parks and recreation centers, competitive leagues for adults, national championship events for all ages and more.

Inasmuch as the USTA's mission is to promote and develop tennis as a means of good health and physical fitness, the USTA is a teaching organization that strives to educate the American populace about the life benefits the sport provides. At the same time, the tournaments and events the USTA sanctions and conducts provide an opportunity for proving the many benefits tennis offers.

A board of directors governs all USTA policy matters. Led by an executive director, who reports to this board, the professional staff of the USTA conducts the organization's day to day business from three offices: national headquarters in White Plains, NY; player development headquarters in Key Biscayne, FL; and the USTA National Tennis Center in Flushing, NY.

United States Tennis Association
Officers and Directors
1997-1998

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USTA Sections

To better serve its members and the general public, the USTA operates through 17 geographic sections. Community programs are the primary emphasis of a section's activities.

USTA Caribbean Section
Minilas Station
P. O. Box 40439
San Juan, PR 00940
787-724-7425
FAX 787-724-7990

USTA Eastern Section
550 Mamaroneck Avenue
Suite 505
Harrison, NY 10528
914-698-0414
FAX 914-698-2471

USTA Florida Section
1280 S.W. 36th Avenue
Suite 305
Pompano Beach, FL 33069
954-968-3434
FAX 954-968-3986

USTA Hawaii Pacific Section
2615 South King Street
Suite 2A
Honolulu, HI 96826
808-955-6696
FAX 808-955-8363

USTA Intermountain Section
1201 South Parker Road
Suite 200
Denver, CO 80231
303-695-4117
FAX 303-695-6518

USTA Mid-Atlantic
2230 George C. Marshall Dr.
Suite E
Falls Church, VA 22043
703-560-9480
FAX 703-560-9505

USTA Middle States Section
460 Glennie Circle
King of Prussia, PA 19406
610-277-4040
FAX 610-239-8999

USTA Missouri Valley Section
801 Walnut St
Suite 100
Kansas City, MO 64106
816-472-6882
FAX 816-472-6677

USTA Midwest Section
8720 Castle Creek Pkwy.
Suite 329
Indianapolis, IN 46250
317-577-5130
FAX 317-577-5131

USTA New England Section
181 Wells Avenue
Newton Centre, MA 02159
617-964-2030
FAX 617-244-8973

USTA Northern California Section
1350 South Loop Road
Suite 100
Alameda, CA 94502
510-748-7373
FAX 510-748-7377

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Suite 101
Bloomington, MN 55431
612-887-5001
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USTA Pacific Northwest Section
4840 S.W. Western Avenue
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Beaverton, OR 97005
503-520-1877
FAX 503-520-0133

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Los Angeles Tennis Center - UCLA
P.O. Box 240015
Los Angeles, CA 90024
310-208-3838
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3850 Holcomb Bridge
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UNITED STATES TENNIS ASSOCIATION

MEMBERSHIP APPLICATION

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☐ **JUNIOR** (under 19)	☐ $ 13.00	☐ $ 35.00	☐ $ 58.00
☐ **ADULT** (19 and over)	☐ $ 25.00	☐ $ 68.00	☐ $104.00
☐ **FAMILY** (2 or more members of the same family; add additional names, dates of birth below)	☐ $ 40.00	☐ $110.00	☐ $180.00
☐ **LIFE MEMBERSHIP**		☐ $400.00	
☐ **REPLACEMENT OF LOST CARD**		☐ $ 2.00	

Please type or print clearly

Last Name _____

First Name _____

Address _____

City _____ State _____

Zip _____ Birthdate Month / Day / Year ☐ Male ☐ Female

Telephone Home _____ Work _____

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____Mastercard ____Visa ____AmEX Card Expiration Date / /

Card No. _____ Signature _____

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P.O Box 5046, White Plains, NY 10602-5046

Phone: 800 770-8782

Check must be in U.S. currency and drawn on a U.S. bank.
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*$11.97 of all membership dues are allocated for a one - year subscription to Tennis magazine for each year of membership except as indicated below. The amounts allocated are not deductible from the membership dues.

* $34.92 of all 3-year junior membership dues are allocated for a 35-issue subscription to Tennis magazine plus one additional issue.
$57.86 of all 5-year junior membership dues are allocated for a 58 issue subscription to Tennis magazine plus 2 additional issue.

For Family membership application, please print additional member's name, date of birth, and sex in the space provided.

First Name	Date of Birth	Sex	First name	Date of Birth	Sex
1)	/ /		4)	/ /	
2)	/ /		5)	/ /	
3)	/ /		6)	/ /	

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___**Coaches guide to Sport Psychology** by Martens $22.00
___**Coaches Guide to Teaching Sport Skills** by Christina and Corcos $22.00
___**Coaching Tennis Successfully** by USTA $18.95
___**The Code** by Col. Powel (quantity discounts available) ..... $ 1.00
___**Conversion Courts** by USTA ..... $ 1.50

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___ **Compass Draw 16Draw/32 Draw** ..... $ 1.50

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___**The Effective Management of Volunteer Programs** by Wilson $12.95
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___**Game, Set, Match** by Bryant $17.95
___**High Tech Tennis** by Groppel $15.95
___**Illustrated Introduction to the Rules of Tennis** by USTA ..... $ .75
___**Intelligent Doubles** by Singleton ..... $ 9.95
___**Level I Sports Competency Test** by USTA $10.00
___**A Manual of Clay Court Tennis Maintenance** by Humphrey ..... $ 7.50
___**Marketing Magic for Volunteer Programs** by Vineyard $12.95
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___**Motor Learning** by Magill $39.95
___**Nancy Clarks Sports Nutrition Guidebook** by Clark $13.95
___**Net Results** by Loehr and Kahn ..... $ 9.95
___**Power Tennis Training** by Chu $14.95
___**Psyched to Win** by Nideffer $11.95
___**Rookie Coaches Tennis Guide** by the American Coaching Effectiveness Program and USTA ..... $ 8.95
___**Rules of Tennis and Cases and Decisions** by USTA (quantity discounts available) ..... $ 1.00
___**Science of Coaching Tennis** by Groppel, Loehr, Melville and Quinn $19.95
___**Sports Health** by Southmayd and Hoffman $18.95
___**Stretching** by Anderson $12.00
___**String Map** by On The Line, Inc $14.95
___**Successful Coaching** by martens $16.00
___**The Successful Volunteer Organization** by Flanagan $14.95
___**Teaching Tennis** - The USTA Way by Tabak $16.00
___**Tennis Courts: A Construction and Maintenance Manual** by USTA and USTC&TBA $39.95
___**Tennis Disputes** by Blue ..... $ 8.00
___**Tennis Doubles** by Lappin with Pfouts ..... $ 9.95
___**Tennis in a Wheelchair** by Parks ..... $ 3.75
___**Tennis Science for Tennis Players** by Brody $19.95
___**Tennis Tactics - Winning Patterns of Play** book and video by USTA ..... (each) $14.95
___**The 5 Keys to Tennis** developed by USPTA, Bollettieri and tenotec $29.95
___**The 5 Keys to Tennis Implementation Manual** by USPTA, Bollettieri and Tenotec $19.95
___**The Tennis Teachers Guide to Group Instruction** by Kraft ..... $ 4.95
___**The Tie-Break system - Information Sheet** by USTA ..... $ 1.00
___**U.S Open at the USTA National Tennis Center** by Saucer with Graves $15.00
___**The USPTA Tennis Professional's Business Manual** by USPTA $15.00
___**USPTR International Book of Drills** by Van der Meer $14.00
___**USPTR Manual of Munchkin Tennis** by Hutslar $14.95
___**USTA College Tennis Guide 1996/1997** by USTA ..... $ 9.50
___**USTA Flexibility Poster** by USTA ..... $ 5.00
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___**USTA Fun Tennis Formats** by USTA ..... $ 3.00
___**USTA Guide to Forming a Community Tennis Association** by USTA ..... $ 4.95
___**USTA Guide to Teaching Sportsmanship** by USTA ..... $ 2.00
___**USTA 1997 Official Tennis Yearbook by USTA**
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Members $12.00
___**USTA National Junior Tennis League Program** Development Guide by USTA ..... $ 3.00
___**USTA Pint Penalty System-Information Sheet** by USTA ..... $ 1.00
___**USTA Recreational Tennis Curriculum** by USTA ..... $ 4.50
___**USTA Schools Program Tennis Curriculum** by USTA ..... $ 4.50
___**USTA Scorebook for Coaches** by USTA ..... $ 4.95
___**USTA Short Tennis Handbook** by USTA ..... $ 2.00
___**Vic Braden's Mental Tennis** by Braden with Wood $11.95
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100

USTA Awards

The Tennis Facility Awards Program honors outstanding tennis facilities and encourages excellence in future construction and/or renovation. Facilities must be under the jurisdiction of (1) a parks and recreation department, (2) an educational institution, or (3) an industrial complex conference center. All facilities are judged in one of four categories, depending upon the number of courts and spectators accommodated.

1981

Biltmore Tennis Center
Coral Gables, FL

Davie Tennis Stadium
Oakland, CA

Gates Tennis Center
Denver, CO

Highland Racquet Club
Birmingham, AL

High Point Park Tennis Center
Plano, TX

Indianapolis Sports Center
Indianapolis, IN

Industrial Hills
City of Industry, CA

John R. McFarlin Tennis Center
San Antonio, TX

Mercer County Tennis Center
West Windsor, NJ

1982

Back Creek Park
Yorktown, VA

Grand Vue Park Tennis Center
Moundsville, WV

H.E. Butt Municipal Tennis Center
Corpus Christi, TX

Indian School Park
Scottsdale, AZ

Kicking Bird Tennis Center
Edmond, OK

Pompano Beach Tennis Center
Pompano Beach, FL

Rebsamen Tennis Center
Little Rock, AR

Ruth Burleigh Tennis Center
Jeanerette, LA

Veterans Park Tennis Center
Hamilton Square, NJ

1983

Lake Park Tennis Club
Lake Park, FL

Memorial Island Tennis Complex
Vero Beach, FL

1984

Central Park of San Juan
Hato Rey, PR

Gillenwaters Tennis and Park Complex
Springfield, MO

I.G. Levy Park Tennis Center
Pascagoula, MS

McCollum Park
Downers Grove, IL

Memorial Park Tennis Center
Colorado Springs, CO

Nielsen Tennis Center
Madison, WI

Oklahoma City Tennis Center
Oklahoma City, OK

South Fulton Tennis Center
College Park, GA

1985

Los Angeles Tennis Center
Los Angeles, CA

Midland Community Tennis Center
Midland, MI

Mt. Lebanon Tennis Center
Mt. Lebanon, PA

Oak Brook Park District Racquet Club
Oak Brook, IL

Old Reid Park Tennis Complex
Springfield, OH

Phoenix Tennis Center
Phoenix, AZ

Sanlando Park
Altamonte Springs, FL

Southern Hill Tennis Center
Shreveport, LA

Tyson Park
Knoxville, TN

102

1986

Augusta-Newman Tennis Center
Augusta, GA

Michigan State University Tennis Facility
East Lansing, MI

Lubbock Municipal Tennis Center
Lubbock, TX

University of Texas (at Arlington) Tennis Center
Arlington, TX

Boynton Beach Racquet Center
Boynton Beach, FL

Club de Tenis de Isla Verde
Isla Verde, PR

1987

Ho Ho Kam Tennis Center
Mesa, AZ

LaFortune Tennis Center
Tulsa, OK

Seattle Tennis Center
Seattle, WA

Bay Trees Community Park Tennis Complex
Castro Valley, CA

Glenview Tennis Club
Glenview, IL

Moranda Park
Port Hueneme, CA

Oxnard Tennis Center
Oxnard, CA

1988

Eck Tennis Pavillion
Notre Dame, IN

Homewood-Flossmoor Racquet and Fitness Club
Homewood, IL

Marjorie Park Tennis Facility
Tampa, FL

Summers Tennis Center
Tyler, TX

Mary Polishman Lard Tennis Center
Ft. Worth, TX

North Fulton Tennis Center
Atlanta, GA

Patch Reef Park
Boca Raton, FL

Penick-Allison Tennis Center
Austin, TX

Kiwanis Park Recreation Center
Tempe, AZ

Jack Nicklaus Sports Center
Kings Island, OH

1989

Desoto Tennis Complex
Satellite Beach, FL

Lloyd Nordstrom Tennis Center
Seattle, WA

Scottsdale Ranch Park
Scottsdale, AZ

Greenburgh Town Park
Ardsley, NY

Jekyll Island Tennis Center
Jekyll Island, GA

Tualatin Hills Park and Recreation District
Tennis Center
Beaverton, OR

The City of Tampa Tennis Complex at
Hillsborough Community College
Tampa, FL

John Drew Smith Tennis Center
Macon, GA

Morley Field Tennis Complex
San Diego, CA

Ralph Wulz Riverside Tennis Center
Wichita, KS

1990

Bertram B. Leopold Recreation Center
Altoona, PA

George S. Eccles Tennis Center
Salt Lake City, UT

Fort Walton Beach Municipal Tennis Center
Fort Walton Beach, FL

Cuesta Park Tennis Center
Mountain View, CA

Jimmy Powell Tennis Center
Elon College, NC

Standford Tennis Stadium
Stanford, CA

William H.G. FitzGerald Tennis Stadium
Washington, DC

1991

Courts Plus
Elmhurst, IL

Dana Hills Tennis Center
Dana Point, CA

Heritage Tennis Club
Arlington Heights, IL

Torrimar Tennis Club
San Juan, PR

The Ashland Tennis Center
Ashland, KY

Cambler Park Tennis Facility
Naples, FL

Forest View Racquet Club
Arlington Heights, IL

Sunnyvale Municipal Tennis Center
Sunnyvale, CA

University of West Florida Tennis Complex
Pensacola, FL

1992

Centennial Tennis
Wilmette, IL

Incline Village Tennis Complex
Incline Village, NV

Memorial Park Tennis Center
Boca Raton, FL

Simpson Tennis Complex
Alton, IL

The University of Illinois
Atkins Tennis Center
Champaign, IL

Burns Park Tennis Center
North Little Rock, AR

La Clanaga Park Tennis Center
Beverley Hills, CA

Mountain View Tennis Center
Phoenix, AZ

Paseo Racquet Center
Glendale, AZ

Tim Korth Tennis Courts at St. Mary's College
Moraga, CA

The Connecticut Tennis Center at Yale University
New Haven, CT

1993

Randolph Tennis Center
Tucson, AZ

Rome Floyd Tennis Center
Rome, GA South

Austin Tennis Center
Austin, TX

Delray Beach Tennis Center
Delray Beach, FL

1994

Ala Moana Tennis Club
Honolulu, HI

Robinswood Tennis Center
Bellevue, WA

David Park Tennis Center
Hollywood, FL

Scott Spelcher Tennis Center
Tallahassee, FL

Tennis Center at Crandon Park
Key Biscayne, FL

1995

Club de Tenis de Ilsa Verde
Ilsa Verde, PR

Torrimar Tennis Club
San Juan, PR

Tennis Center of Coral Springs
Coral Springs, FL

Kiwanis Recreation Tennis Center
Tempe, AZ

Fremont Tennis Center
Fremont, CA

Basil-Rudd Tennis Center
University of Louisville
Louisville, KY

McCormack-Nagelson Tennis Center
College of William and Mary
Williamsburg, VA

Heflin Tennis Center
Oachita Baptist University
Arkadelphia, AR

1996

Payne Park Tennis Center
Sarasota, FL

McMurry Tennis Complex
Sulphur, LA

Monterey Tennis Center
Monterey, CA

L.B. Houston Tennis Center
Dallas, TX

Augusta-Newman Tennis Center
Augusta, GA

Cooper Creek Tennis Center
Columbus, GA

Mercer County Tennis Center
Trenton, NJ

Mt. Lebanon Tennis Center
Mt. Lebanon, PA

Nellson-Screen Tennis Stadium, Hampton University
Hampton, VA

1997

Pelican Bay Community Tennis Center
Naples, FL

Treasure Island Golf, Tennis and
Recreational Center
Treasure Island, FL

Burlington Tennis Center
Burlington, NC

Charleston Tennis Center
Charleston, SC

Indian School Park
Scottsdale, AZ

Lagoon Park Tennis Center
Montgomery, AL

Midland Community Tennis Center
Midland, MI

Peachtree City Tennis Center
Atlanta, GA

Van Der Meer Shipyard Racquet Club
Hilton Head Island, SC

Duchossis Tennis Center - Washington
and Lee University
Lexington, VA

Snyder Tennis Center - University of Virginia
Charlottesville, VA

International Tennis Center
at Stone Mountain Park
Stone Mountain, GA

1998

University of Redlands Tennis Facility
Redlands, CA

Sunrise Tennis Center
Sunrise, FL

USTA National Tennis Center
Flushing Meadows, NY

Burgess-Rushing Tennis Center
Lubbock, TX

Plaza Tennis Center
Kansas City, MO

Richland Tennis Center
North Richland Hills, TX

Arthur Ashe Tennis Center at Battery Park
Richmond, VA

Mary Potishman Lard Tennis Center
Fort Worth, TX

Taube Family Tennis Stadium
at Stanford University
Stanford, CA

The Tennis Center at Alburgue Olimpico
Salinas, PR

Jimmy Evert Tennis Center
Fort Lauderdale, FL

Chapter VI

Indoor Tennis

See Your Game In A Whole New Light

As the industry leader in building and renovating indoor sports facilities, ICA has the products and services you want to enhance playing indoors.

- **Caindle** Lights
- **Energy Miser** Insulated Ceiling Systems
- **SportsFlex** Air Supported Structures
- **Excel** Backdrop Curtains
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Indoor Tennis

In designing or renovating indoor tennis facilities, the principal elements to consider are the court enclosure, ceiling system and insulation, HVAC (heating, ventilation and air conditioning) system, lighting, court surface or surfaces, perimeter curtains, divider nets and additional facilities including pro shop, food service, locker rooms, fitness facilities and social areas. Some of these items are beyond the scope of this book and much has already been written in the trade press regarding pro shop design, locker rooms and indoor tennis amenities. This chapter will concentrate, therefore, on tennis enclosures, ceiling systems, insulation, HVAC systems, lighting, indoor court surfaces, perimeter curtains and divider netting.

As with any tennis facility, it is clear that players are attracted to indoor facilities which are inviting and functional and which play well. Time and money spent on developing a quality tennis environment, coupled with well-planned programming, will attract members and increase the return on the investment in indoor tennis. In addition, since indoor tennis facilities require enclosures, heating, ventilation and air conditioning as well as lighting, more consideration should be given to initial and long term costs in planning these facilities in order to insure operating efficiency.

Court Enclosures

Size

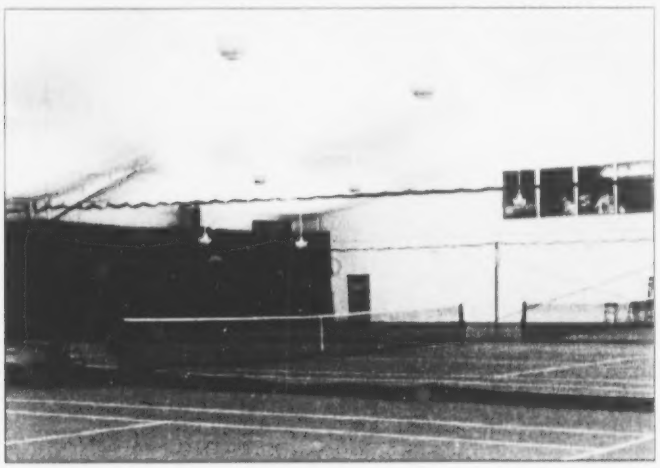
In constructing an indoor tennis facility, consideration should be given to the appropriate dimensions of the enclosure. Often enclosures designed for other purposes are adapted for use as tennis court enclosures. Unfortunately, these enclosures do not always provide adequate clearance for a suitable tennis court layout. Therefore, care must be taken in choosing appropriate structures and in designing the interior layout.

The outside dimensions of the playing lines of a tennis court are 36' (10.973m) X 78' (23.774m) for doubles, 27' (8.230m) X 78' (23.774m) for singles. An overall court area at least 60' (18.288m) X 120' (36.576m) is strongly recommended for an individual court. For tournament play where judges are required, a court area of 66' (20.117m) X 132' (40.234m) is recommended, providing a clear playing area of 60' (18.288m) X 120' (36.576m) with additional area for the judges and a safe overrun area for the players. This court area is exclusive of walkways, structural members, seating, etc.

Not less than 12' (3.658m) from the sideline to a fixed obstruction (side stop, light pole, building column or wall) is recommended. For a battery of courts within a common enclosure, a 24' (7.315m) separation between courts is recommended and 18' (5.487m) is considered minimum. Use of divider netting is recommended. Where light poles, benches or other fixtures must be placed between courts, they should be placed at the net line.

The space directly over the court should be free of overhead obstructions and should be not less than 18' (5.487m) at the eaves, 21' (6.401m) over the baseline and 35' (10.668m) at the net, although 38' (11.582m) is recommended, measured to the interior finished ceiling.

There should be at least 18' (5.487m) behind the baseline to the backdrop curtain; 21' (6.401m) is recommended. To accommodate arriving and departing players, there should be a passageway behind the courts at least 3' (914mm) wide, separated from the court by an opaque backdrop curtain. The curtain must extend at least 12' (3.658m) above the finished court surface.



A view of an indoor tennis court, showing the ceiling and lighting system. The court shows excellent use of space, and also includes backdrop curtains, divider nets and spectator seating. Another observation deck is located above the court, allowing spectators to come and go without disturbing the players. PHOTO COURTESY OF INDOOR COURTS OF AMERICA.

Types

There are three types of tennis court enclosures, all of which can be erected temporarily or permanently: air structures (or bubbles), tension-supported fabric structures and rigid framed metal buildings. Both air structures and tension structures may offer some tax savings over steel buildings since they are counted as temporary structures, not buildings, for property tax purposes in some localities. All three types of enclosures are considered relocatable and, therefore, they all have some resale value.

Air Structures

Air structures, or tennis bubbles, are single- or multi-ply fabric structures which are supported by air pressure supplied by air blowers, which also can provide ventilation, heating or air conditioning. Where air structures will be heated or air conditioned, multi-ply structures are recommended. The average air structure covers 1-5 courts, but such structures can be manufactured to cover any number of courts.

Air structures are especially suited for seasonal use. They can be put up over courts for winter and removed during warmer weather. In areas where snow loads are anticipated, air structures must include heating systems to reduce snow accumulation and should have perimeter fences designed to facilitate snow removal.

Air structures consist of three components: fabric, inflation system and anchorage. Because of their simplicity, they represent a very efficient type of construction and are, therefore, relatively inexpensive. They are, however, subject to building codes and in most cases, building permits are required for their installation. For example, by code, air structures must be designed to withstand a minimum of 80 mph (125 km/hr) winds.

Most air structures are constructed of woven polyester fabric (24 oz. to 32 oz.), often finished with protective coatings. The coatings allow the fabric to stay clean and screen out ultraviolet light to reduce fabric degradation. In multi-ply bubbles, one or more additional layers of fabric are added for insulation. Additional layers of fabric reduce the translucency of the air structure. Because the fabric is strong and often coated, the average life expectancy of a well-maintained bubble is 8-12 years. Tears in the fabric can be easily repaired.

The fabric used in these structures may be translucent or opaque. Translucent fabrics allow natural light to enter and increase thermal gain during the winter. However, the light passing through the membrane is usually uneven; therefore, players often require the lights to be turned on even during daylight hours. Translucent structures are extremely difficult to cool during warmer weather. Opaque structures provide more consistent interior lighting and temperature control.

An air structure is shipped to the site in various sections on pallets. It is assembled on the site. The fabric structure is attached to a concrete foundation, designed to withstand uplift forces of more than 1,000 lbs. (607 kg) per linear foot. Most air structures use a continuous concrete grade beam around the perimeter of the bubble. The fabric is then bolted to the grade beam or attached with a "quick anchorage system" consisting of 2" X 4"s inserted in channels in the grade beam. If the air structure will be removed during warm weather, consideration must be given to designing the anchorage system in such a way that it will not pose a player hazard when the fabric membrane is removed. For example, the grade beam must be designed flush with the court surface and must follow the slope of the court. All attachment hardware also must be mounted flush or be removable and all channels for attachment must include some provision for filling them or covering them once the air structure is removed. In general, courts should be designed for installation of air structures, although it is possible to retrofit an air structure to an existing court.

Some air structures include an additional anchorage system consisting of metal cables or fabric webbing spanning the exterior surface of the structure. These are called stress relief systems since they reduce the stress on the fabric. They provide additional anchorage and further protection of the structure from damage during high winds.

Air structures are supported by low-horsepower blowers. Generally there are a primary inflation system, a secondary inflation system and an emergency generator or back up engine, even though it takes about an hour for a fully inflated bubble to collapse. Often air structures are equipped with pressure alarm systems to alert the building operator to any critical drop in building pressure. The heating system may be coupled with the blower system or it may be equipped with a separate blower.

Air structures require airlock entrance systems, usually revolving doors. Emergency exits and equipment/handicapped accessible entrances are incorporated in the design as well.

Some manufacturers offer turnkey installation, but some insist that the process is simple enough that air structures can be put up and taken down by owners. They are generally designed in sections for ease of handling and installation. To maximize the useful life of the fabric, the structure should be stored indoors or shielded from the sun when not in use.

Air structures can be attached to rigid structures such as permanent buildings or clubhouses.

The major advantage of air-supported structures is their suitability for seasonal use. In addition, air structures are substantially less expensive in terms of initial construction cost than comparably sized tension-supported or rigid framed structures. Finally, air structures offer a clear span; limited maintenance except for mechanical systems; speed of delivery, installation and dismantling.

Tension-Supported Structures

If the court enclosure will be left up year round, another option may be a tension-supported structure. Tension-supported structures are substantially more expensive than air structures initially, but they provide savings in the long run.

These court enclosures consist of an aluminum or steel frame with fabric, similar to that used in air structures, stretched tightly across the framework. An interior liner can be installed to increase the insulation properties of the structure for heating or cooling. Most snow loads can be accommodated. Tension-supported structures commonly cover 1-6 courts although they can be designed to cover any number of courts.

Tension-supported structures are particularly useful in hot climates where they can shade courts during the heat of the day while providing ventilation through removable or retractable walls.

Tension-supported structures with stretched fabric should last 15 - 20 years prior to fabric replacement. The frame should last 20 - 40 years or longer if properly maintained.

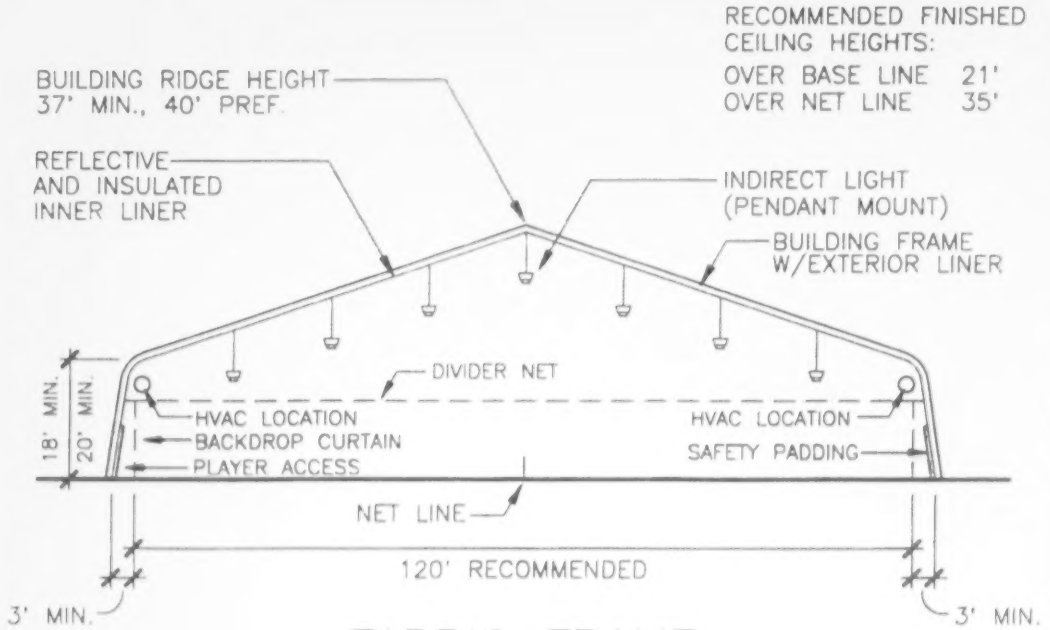
This exterior view of a residential indoor tennis court building shows its interesting architectural design, ample parking and attractive landscaping. PHOTO COURTESY OF INDOOR COURTS OF AMERICA.

Steel Buildings

Rigid framed buildings for tennis are usually made of steel. Although highest in initial cost, steel buildings offer some advantages over air structures and tension-supported structures. They can be insulated more effectively, providing more efficient energy utilization and lower long term costs. They are durable and they require little maintenance. These buildings have a useful life of 20 - 40 years or longer if properly maintained.

Rigid framed tennis buildings cannot be taken down in warm weather; however, they are considered relocatable. They can be built without walls or with removable walls for ventilation.

In the past, steel buildings designed for other purposes have been adapted for use as tennis court enclosures. These standard buildings, called "wide span" buildings, measure 120' (36.576m) from outside wall to outside wall.



FABRIC FRAME COURT BUILDING SECTION

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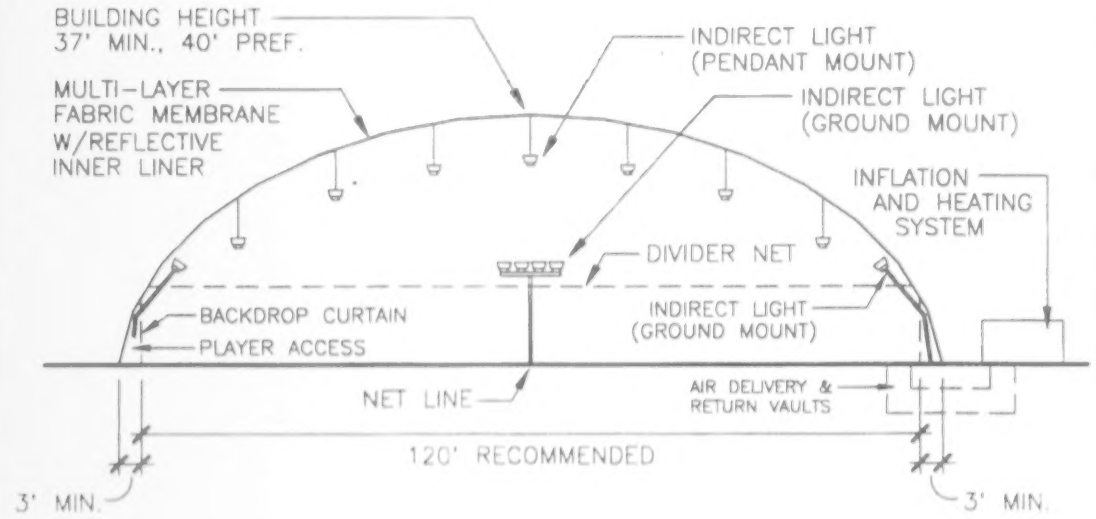

AIR SUPPORTED STRUCTURE COURT BUILDING SECTION

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Columns placed on the inside extend 18" (457mm) to 36" (914mm) into the interior of the building. This yields a useful space of only 114' (34.747m), 6' (1.829m) less than the recommended length of the tennis court area. The cost of wider spans to accommodate a full sized court has historically been prohibitive. More recently, however, a new design has been developed. These "long-bay" buildings utilize columns located 50' (15.240m) - 60' (18.288m) on center integrated into the outside walls. With no columns protruding into the building behind the baseline, these long bay buildings maximize the court space. Long bay construction, however, makes use of columns located between net posts to minimize the size of ceiling beams.

Padding

Where they exist, support columns in permanent buildings or in tension-supported structures should be padded with shock-absorbing material (foam rubber at least 2" (51mm) thick is recommended). It is recommended that any structural member within 12" (305mm) of a permanent, opaque curtain should be padded. The padding should begin flush with the court surface and should extend at least 8' (2.438m) above the court surface.

Ceiling Systems and Insulation

Ceiling systems in tennis buildings improve the appearance of indoor tennis facilities and serve two other important purposes. They offer a highly reflective surface to improve the performance of lighting systems and they provide significant insulation, enhancing the performance of the HVAC system. In addition, they provide a vapor barrier and assist in controlling condensation within the structure.

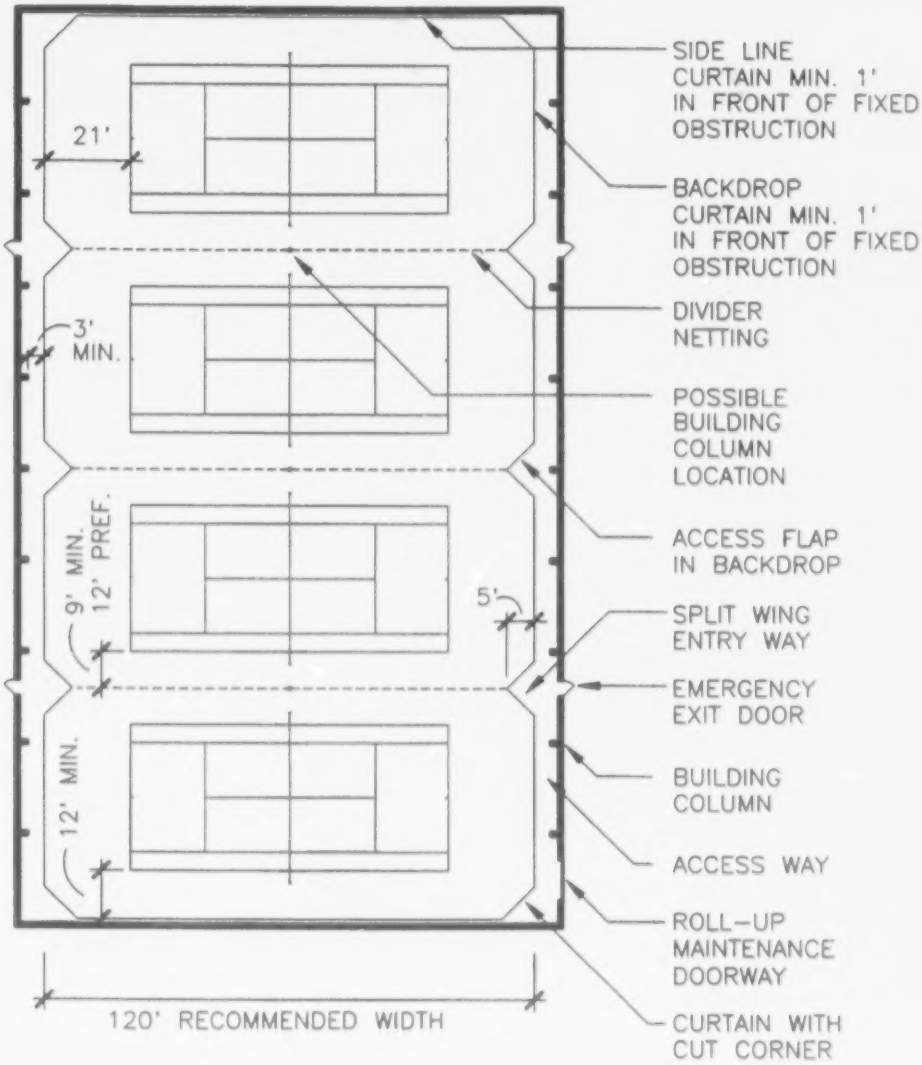
Most ceiling systems consist of a highly reflective, reinforced white fabric backed by fiberglass insulation. Ideally, the ceiling system should be suspended inside the building framing. In this way, the structural steel beams, which transfer heat from the roof surface in the summer and generate condensation in the winter, are isolated from the building interior. A ventilated air space between the structure and the suspended ceiling system increases thermal efficiency and virtually eliminates condensation problems. A suspended ceiling system also creates a uniform surface to reflect light, minimizes shadows and improves the overall appearance of the facility.

HVAC Systems

An HVAC (heating, ventilation and air conditioning) system for an indoor tennis enclosure should be capable of changing the air within the structure 1-4 times per hour with minimal noise or draft. In the winter, the heating system should be able to maintain the building temperature at between 55 and 62 degrees Fahrenheit (13 - 17 degrees Celsius). In the summer, air conditioning should maintain an indoor temperature of 10 to 15 degrees Fahrenheit (6 - 8 degrees Celsius) below the outside temperature with 55% - 60% humidity. The HVAC system should be sized after accounting for the losses related to the structure (particularly important when translucent bubbles are involved) and for the ceiling systems and insulation included in the design.

Low intensity gas fired infrared heating systems that are completely sealed and exhaust to the outside are recommended for indoor tennis since they are efficient, compact and quiet. They are able to effectively heat a tennis enclosure without the need for duct work, fans or blowers. If necessary, duct work for heating or cooling systems should be mounted behind and slightly above the backdrop curtain where it does not interfere with lighting and where it can be more easily maintained. Duct work should not be located over the playing area or between courts. In designing the HVAC system, it is desirable to place vents either between courts or at the netline to minimize interference with play. Air should never blow across the court or directly on the players.

NOTE:
PROVIDE PLAYER ACCESS
BEHIND ONE END OF
ALL COURTS, MIN.
BOTH ENDS PREFERRED



INDOOR TENNIS BUILDING PLAN

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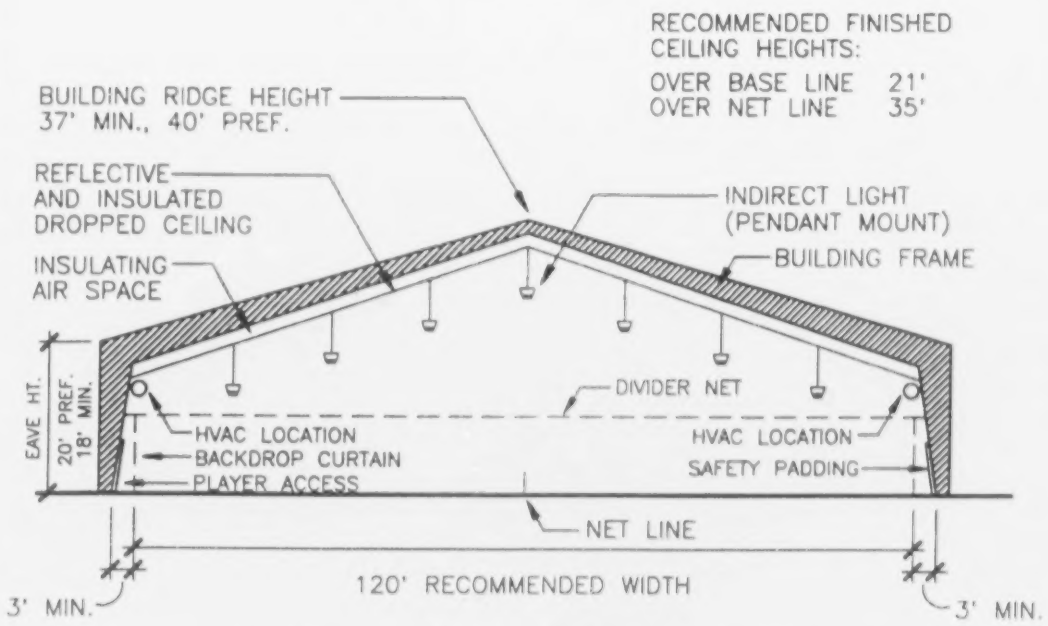

WIDE SPAN STRUCTURE
COURT BUILDING SECTION

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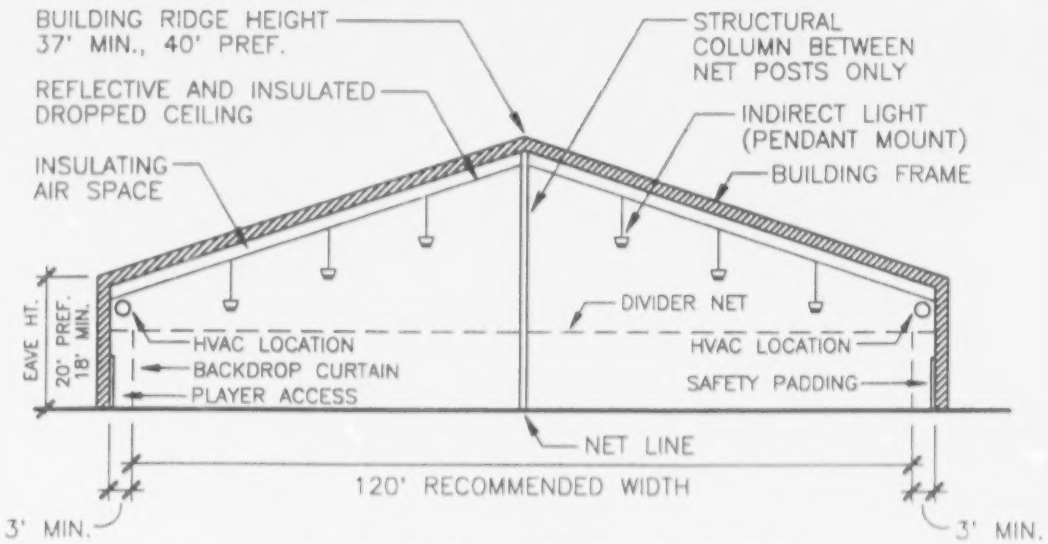

LONG BAY STRUCTURE
COURT BUILDING SECTION

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Indoor Lighting

Lighting for indoor tennis should be uniform and glare-free. All lighting systems should be designed to provide adequate visibility of the ball along every possible path while in play, for both players and spectators, with minimum glare.

The USTC&TBA and the USTA recommend the average maintained levels of illumination listed on the chart which follows.

See Chapter V for general information on tennis court lighting.

Direct Lighting

Historically, indoor tennis facilities have used direct lighting, or down lighting, using 8' (2.438m) fluorescent lamps. Fluorescent fixtures were placed 13' (3.962m) - 22' (6.706m) over the court surface and outside the alleys parallel with the sidelines of the court. HID light sources also have been used for direct lighting for indoor tennis. These systems proved to be inefficient, costly to operate, and generated significant glare, which was distracting for players.

Indirect Lighting

The most common type of lighting for indoor tennis today is indirect lighting, or uplighting, involving the installation of fixtures aimed at a highly reflectant ceiling. Metal halide or other high intensity lamps are used. They should be mounted no closer than 6' (1.829m) from the ceiling to avoid "hot spots." The number of fixtures needed will depend on the height of the ceiling, its reflectance and the level of lighting required. In steel buildings, exposed beams will significantly decrease the efficiency of an indirect lighting system, while a suspended ceiling system will significantly increase its effectiveness.

Design and Placement of Indirect Lighting Fixtures

Whenever possible, lighting fixtures should be placed between courts and away from the corners, so that players do not have to look directly into the lights when serving or playing a high shot. When a player looks directly into a light source, an after image of the light causes momentary blindness.

Lamps must be protected from balls coming down on top and lodging in the fixtures. If fixtures include lenses, they must be non-breakable or protected from a direct hit by the ball. In addition, light fixtures should be designed to minimize damage due to condensation within the structure and should be UL approved for use in damp locations.

Another important consideration in choosing a lighting system is maintenance. Tennis requires a high level of uniform, glare-free light. Relamping, as appropriate, and keeping fixtures clean is essential to providing efficient, quality lighting. Therefore, a lighting system should be chosen which facilitates regular cleaning and maintenance.

Lighting fixtures may be pendant-type (hung from the structure or, in air structures, from cables) or pedestal-type (mounted on poles installed at the court surface). Pendant systems can provide uniform, glare-free lighting. Pedestal type systems, on the other hand, are less efficient in providing uniform lighting because they must be located on poles between courts either at the net line or at the rear of the court. The poles must be padded and even if padded, can be a player hazard.

RECOMMENDED ILLUMINATION FOR INDOOR TENNIS FACILITIES				
PERFORMANCE CRITERIA	RECOMMENDED			MINIMAL
	EXCELLENT	VERY GOOD	GOOD	FAIR
Average Maintained Horizontal Footcandles within PPA 1, 2, 4	125	100 - 75	75 - 60	50
Minimum Maintained Horizontal Footcandles within PPA 2, 4	100	100 - 60	60 - 50	40
Maximum Uniformity Ratio 3	1.50	1.50	1.70	2.00

Notes:

1. Maintained horizontal foot candles is determined by applying a light loss factor (LLF) to the initial calculated or measured foot candles. LLF is dependent upon lamp characteristics, fixture design, fixture maintenance, voltage variations and atmospheric conditions. It normally varies between .6 - .85. Consult the *Illuminating Engineering Society handbook* and fixture manufacturer's publications for proper LLF values.

2. Average maintained and minimum maintained horizontal foot candles should be calculated within the playing lines and/or within the Primary Playing Area (PPA) determined by the specifications of the project with foot candle values multiplied by the appropriate LLF.

3. Uniformity ratio is defined as the ratio of maximum foot candles divided by the minimum foot candles.

4. Primary Playing Area (PPA) is defined as the area that includes 6' beyond the sidelines and 10' behind the baseline.

5. For equivalent lux measurements, multiply foot candles by 10.76

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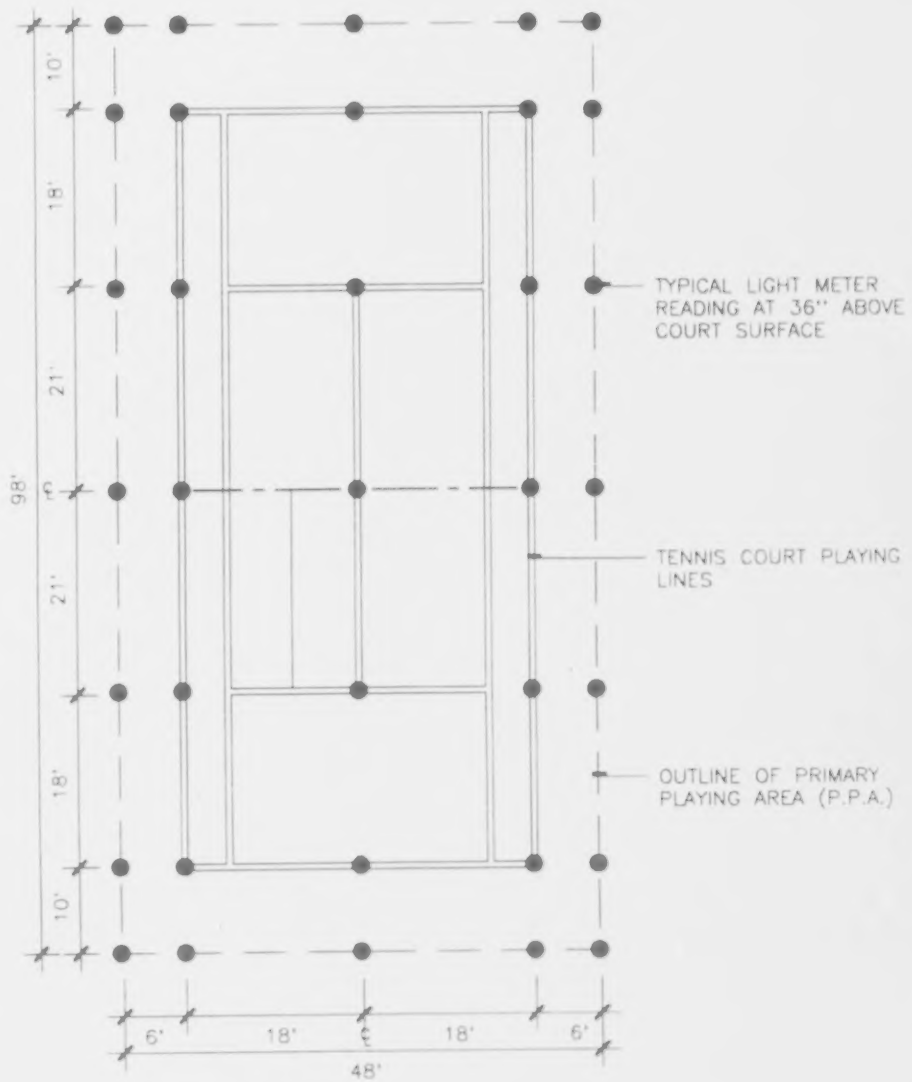

LIGHT METER READING LOCATION DIAGRAM

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181

In air-supported structures, pendant light systems should be strong enough to support the weight of the fabric and snow if the structure comes down in a storm and pedestal light fixtures must be rapidly demountable or collapsible, so as not to destroy the fabric membrane if the structure collapses.

Color Contrast

In designing indoor facilities, for optimum color contrast between the court surface, the background and the ball, it is important to use medium dark colors completely around the court to a height of about 8' (2.47m) on the sides minimum, 12' (3.658m) is preferred, and 12' (3.658m) - 14' (4.267m) behind the court. Above that level, a white or very light matte finish is suggested.

Wiring

Designers should consider using 277/480 volt service in lieu of the usual 120/208 volt service to reduce wiring costs. All electrical conduit for air structures should be buried in the concrete grade beam during construction. Junction and wiring pull boxes should be flush mounted within the grade beam or court surface, as well, so as not to be a player hazard when the air structure is removed during warm weather.

It is recommended that remote switching to turn lights off and on at the central counter be provided; however, wiring all court lighting to the counter will be an additional expense. A duplex outlet at each court, another extra expense, is also highly desirable to facilitate maintenance and the use of ball machines and teaching aids.

Court Surfaces

Traditionally, indoor court surfaces have been asphalt pavement with an acrylic tennis coating. Cushioned surfaces, sand-filled turf and color coated concrete courts also are well suited for indoor tennis use.

Clay and fast dry surfaces have been used in indoor installations also, but up until recently they have not performed well. Outside, it is the constant exchange of air and water between the court and its environment, as well as changing temperatures and weathering including freeze/thaw cycles, which keeps the court soft. Indoors, because of reduced ventilation and more constant temperatures, fast dry and clay courts become very hard. In addition, the above ground sprinkler systems traditionally used with fast dry surfaces have resulted in excessive humidity in indoor facilities. The development of subsurface irrigation systems and improvements in HVAC systems for tennis enclosures, especially improved insulation and ventilation, have led to improvements in the performance of these courts and increased owner satisfaction. While they still become harder indoors, clay and fast dry courts remain popular with players because they retain their slide. Most manufacturers of fast dry materials produce a specific blend for use on indoor courts to compensate for hardening and to enhance the slide characteristics associated with such courts.

The type of surface chosen may have some impact on the enclosure design. Heavy duty equipment may be required for the maintenance and repair of tennis courts, especially soft courts, and an appropriate means of access should be included in the design of the building. Fast dry courts may require some special consideration in the design of insulation and HVAC systems to avoid problems with excessive humidity and/or condensation. In addition, some provision will need to be made to protect the building from moisture since fast dry courts will require regular irrigation. Without rain, hard courts will require regular vacuuming or sweeping. Convenient maintenance equipment storage and appropriate electrical outlets should be included in the design.

Where courts will be covered seasonally, consideration should be given to sloping the courts for drainage when uncovered. Ordinarily, permanently enclosed indoor courts have no slope.

For more information on tennis court surfaces, see Chapter IV.

Perimeter Curtains

Indoor tennis facilities use perimeter curtains to provide a background against which to see the ball, to keep balls within the court and to screen out the distraction of players going to and from adjacent courts. Perimeter curtains should be a minimum of 12' (3.658m) high; however, curtains may be as high as the wall. Curtains should be designed to overlap from 12" (305mm) - 24" (610mm). They are normally made of vinyl fabric in weights ranging from 10 oz. - 22 oz. (18 oz. is recommended). All curtains must meet Federal, NFPA, UL and applicable local fire code requirements. Curtains may have two-ply, three-ply or web strap top hems with brass grommets spaced 6" (152mm) - 24" (610mm) apart for hanging. Side and bottom hems should be at least two-ply. Where sections of curtain are seamed, they should be dielectrically welded for strength. Rod pockets or weighted bottom hems may be appropriate in certain instances and are generally recommended with lighter weight curtains.

The appropriate height for hanging perimeter curtains is the subject of some disagreement. Some facility owners prefer curtains which hang 1/2" (13mm) - 2" (51mm) above the court surface for a neat finished look. Others opt for curtains which lay on the surface, providing better ball containment and preventing the curtains from swaying. This type of installation may lead to wear on the curtain bottom and abrasion of the court surface.

Perimeter curtains must be equipped with some form of a court entryway. There are several options available including overlap between the curtains, doorways in end curtains or split wing entries which are part of the divider net and/or the back wall perimeter curtain. A separate doorway curtain with a mesh viewing window is recommended for club play.

In some facilities, light colored high-line curtains are used above perimeter curtains. Where used, high-line curtains are normally white to reflect light back onto the court surface, but colors other than white are sometimes used. High-line curtains usually extend from the ceiling to approximately 12" (305mm) - 24" (610mm) below and behind the top of the perimeter curtains. High-line curtains may be made of any vinyl material. Like perimeter curtains, they must meet appropriate fire codes. Where panels are seamed, they should be dielectrically welded. Two- or three-ply top, bottom and side hems are recommended. Top hems will include grommets spaced 18" (457mm) - 24" (610mm) apart for hanging.

Divider Nets

Divider nets are available in polypropylene, knitted polyester and nylon. They may be mesh or a combination with the bottom portion made of solid vinyl and the top portion made of vinyl coated mesh. Nets must meet applicable fire codes.

The top of divider netting should be strung 10' (3.048m) - 12' (3.658m) above the surface of the court. Twelve foot (3.658m) nets are preferred to keep balls on the court. The bottom of the netting should not be anchored to the surface in any way nor should nets drape on the surface as this can lead to player injury. Because nets which drag on the surface are subject to significant abrasion, to extend life of the curtain and to minimize the player hazard, netting can be hung 1/2" (13mm) - 2" (51m) above the surface of the court, finished with a solid vinyl skirt or include a detachable bottom which can be removed when worn.

Netting should be hung in two pieces that may be drawn to the ends of the court or to the center for court maintenance.

Divider nets are generally available in dark green and black, both of which minimize visual impact and provide an adequate background against which to see the ball.

Installation

Perimeter curtains, high-line curtains and divider nets can be supported by cable and turnbuckle, high-tension wire or a track system. High tension wire is recommended because it is maintenance free and provides a finished appearance.

Tennis in an Athletic or Fitness Club[5]

IHRSA, The International Health Racquet and Sportsclub Association, was founded in 1981 when the boards of the National Tennis Association (300 commercial indoor tennis facilities) and the National Court Club Association (several hundred racquetball clubs) voted to merge. The immediate focus of the new association was to aid member clubs in diversifying their facilities into multisport and fitness centers in order to salvage the investments owners had made in single sport facilities which, at that time, considerably exceeded demand for their sports.

During the early 80s, indoor tennis courts were put to use serving double duty as badminton courts, basketball courts and even go cart tracks (during the off season), with varying success. Surface requirements made tennis incompatible with basketball for serious use.

Permanent conversions of indoor tennis space became more popular as demand for indoor tennis continued to wane in the 80s. Single courts were most often converted into indoor swimming pools or fitness centers and aerobic studios, with some double-decking of space. These conversions allowed many tennis clubs to survive and thrive.

The multisport athletic and fitness club is able to serve from two to four times the number of members and to command higher annual or monthly dues, while maintaining court fees and program/lesson fees in tennis. Multisport clubs generate from two to four times the revenue per square foot of a typical indoor tennis-only club (the average revenue per square foot in a recent IHRSA survey was $41 in multisport clubs versus $17 in tennis-only clubs). In the last few years, however, as a renewed interest in tennis seems to have arisen, some tennis-only indoor clubs have been able to generate net income margins of over 10% before taxes, which are among the healthiest in the commercial club industry.

Today, indoor tennis is an integral part of the multisport athletic and fitness club industry. Over 650 clubs with tennis belong to IHRSA, with 430 having indoor tennis in permanent or air-supported structures. The total number of indoor courts in IHRSA clubs is estimated at 2000 to 2500, and the estimate for the number of players served per indoor court is (at 125 per court) 2.5 - 3.0 million. Of the approximately 4.5 million people who played tennis 25 times or more in 1995 (according to research performed by American Sports Data, Inc.), IHRSA estimates that 50% of these played in its indoor member clubs.

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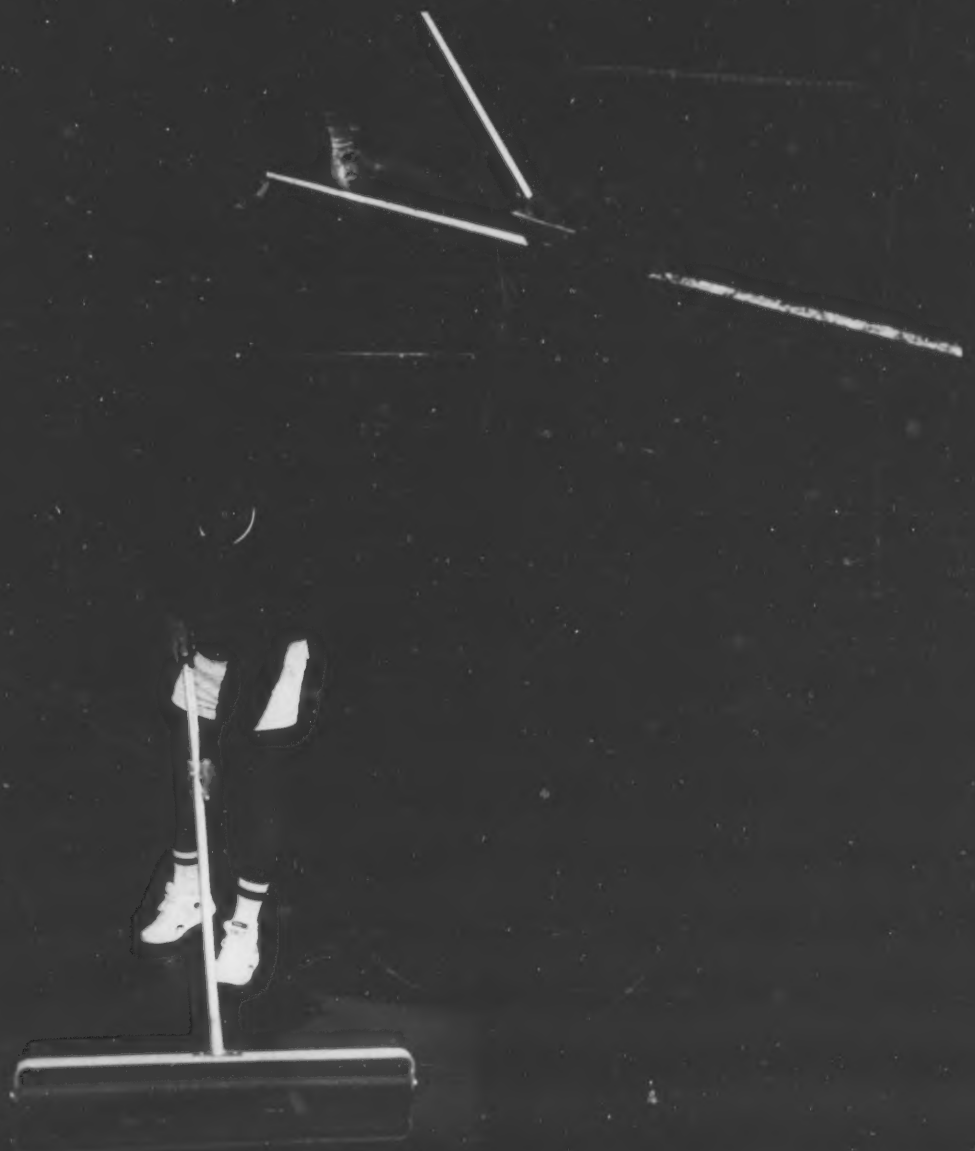
5 By Rick Wilcox, International Health, Racquet & Sportsclub Association

Chapter VII

Care and Maintenance



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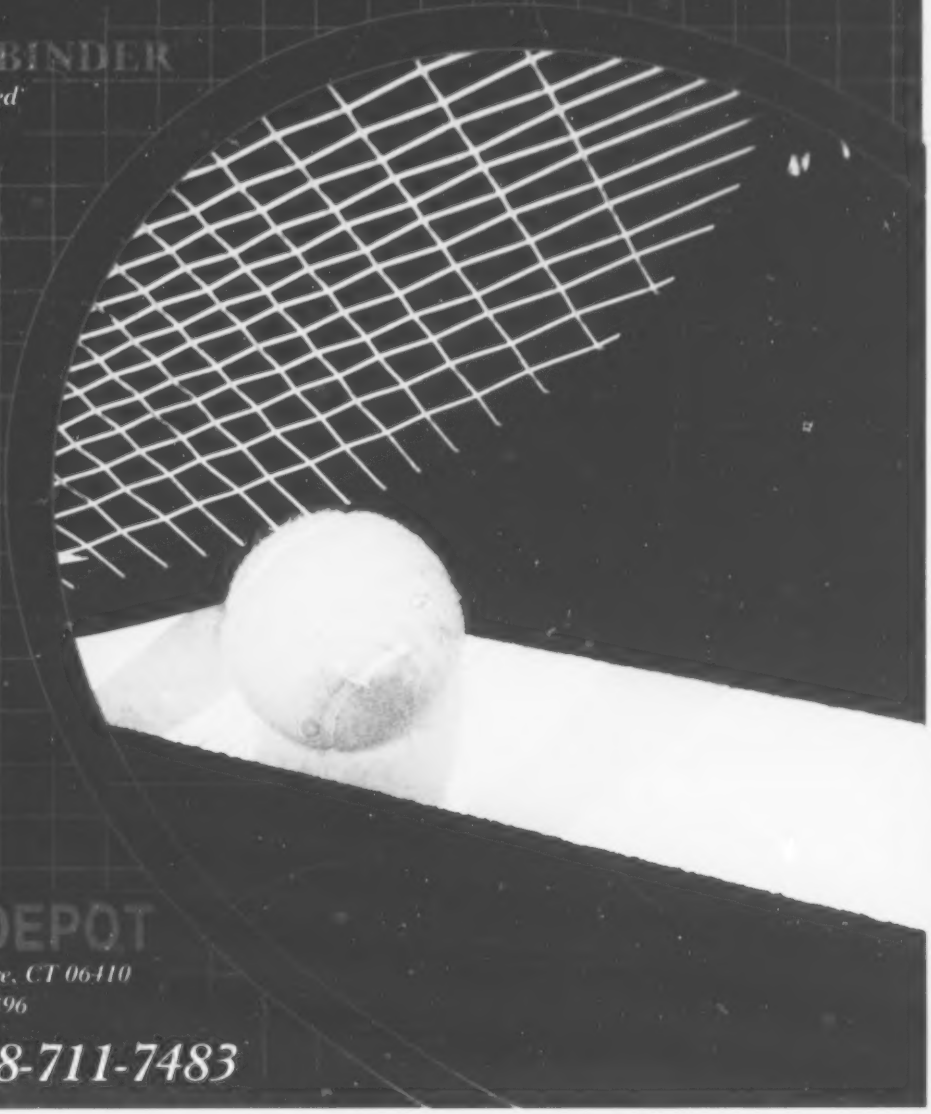

PAVEMENT DEPOT

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Care and Maintenance

General Maintenance

A well-constructed and well-maintained tennis court will offer years of play. To maximize the useful life of any type of court, the owner should develop and implement a regular schedule of maintenance. Regular inspection of the court and repair of minor irregularities is more cost effective than allowing the court to deteriorate to the point where it requires major repair or reconstruction. Even with regular maintenance, over time, all courts will need some repair.

The most important step in maintaining all types of court surfaces is to keep them clean by removing debris immediately and by spot cleaning spills as soon as they occur. Practice preventive maintenance by prohibiting food and beverages (except water) on the court area and by prohibiting smoking on the court. Provide wastebaskets to encourage players and spectators to keep the surface clean. Pick up stray balls, ball cans and "pop-tops" which can damage the court surface, become a tripping hazard and make the court area unsightly.

Require proper footwear, even for spectators. Athletic shoes with black soles will leave marks on hard court surfaces, while hard-soled street shoes may damage any type of surface.

Watch for dirt, mud, snow or water tracked onto courts. Wet spots can make walkways and court surfaces slippery and potentially hazardous while abrasive materials, such as sand or dirt, can cause premature wear to court surfaces. Additionally, balls tend to skid when landing on spots where dirt has accumulated.

At the end of the playing season, inspect all court equipment and order any replacement parts so that the equipment can be repaired during the off season. If new equipment is needed, the end of the season may be a good time to shop for bargains.

The amount of maintenance required by a particular tennis facility will vary depending upon the geographic location, the amount and type of use, player conduct and alternative use, if any. In any case, the owner should develop an appropriate maintenance plan, ensure that maintenance is performed at timely intervals and keep records of maintenance procedures and conditions or problems noted. The need for excessive maintenance may be an indicator of more serious problems.

Tennis Industry Magazine's Annual Maintenance Planner

Maintenance Items	Tasks		
	Pre-Season	As Required	Daily
Court Surfaces (outdoor):			
Hard	Power wash; clean & fill cracks. Check for birdbaths, repair as req'd.	Clean off spills and other contaminants. Sweep or blow clean after heavy rain.	
Fastdry	Remove dead material.Topdress with new material; install lines.	Broom court and brush lines. Minor patching, as req'd.	Water court (sometimes twice per day). Broom and brush court lines.
Sand-Filled Turf	Wash court surface. Apply sand topdressing as req'd.	Repair as required in heavily used areas.	Sweep surface clean of debris.
Grass	Roll and fertilize grass. Gradually mow to playing height.	Fill/repair divets and gouges in grass. Line courts.	Water surface, mow if required. rotate court position or let court "rest".
Court Surfaces (indoor):			
Hard	Power wash surface. Clean and fill cracks or surface tears.	Clean off spills and other contaminants.	Vacuum or sweep surface.
Fastdry	Pulverize surface crust as req'd. Top dress w/ surface material as req'd.	Broom court and brush lines. Fill low spots and reset lines.	Lightly hand water court as req'd. Broom and brush court lines.
Sand-Filled Turf	Wash court surface. Apply sand topdressing as req'd.	Replace sand as required in heavily used areas.	Sweep surface clean of debris.
Court Accessories:			
Nets	Install net, adjust height and tension.		
Net Posts	Clean out sleeves, paint as req'd., install posts and lubricate mechanisms.	Check for cracking and repair as needed around net posts.	
Fencing	Check that frame and fabric are secure and free from hazards.	Straighten or replace damaged frame or fabric elements.	
Windscreens	Install windscreens.	Repair rips and tears.	Check that windscreens are securely fastened to fence framework.
Irrigation	Turn on water supply, test system, set meters, set timer clocks.		Check and record water usage.
Lights (Outdoor)	Clean lenses and check wiring/conduit, set timer clocks.		
Lights (Indoor)	Clean lenses and check wiring/conduit.		
Court Maintenance Equip.	Clean, lubricate, test.		
Court Buildings			
Air Structures	Erect structure, test all systems. Review emergency staff proceedures.		Record pressure, temperature, weather conditions, inspect for leakage.
Metal Buildings	Check and test all HVAC systems.		Check safety padding.
Related Facility Concerns:			
Drainage	Check systems, clear structures and pipes.	Repair damaged structures or pipes.	
Landscaping	Prune back overgrowth, fertilize, install seasonal plantings, mulch beds.		Water plantings.

U.S. TENNIS COURT AND TRACK BUILDERS ASSOCIATION

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Tennis Industry Magazine's Annual Maintenance Planner (cont.)

Tasks			
Weekly	Monthly	Post-Season	Long Term Planning
Sweep or blow surface clean	Check for surface cracking	Sweep or blow surface clean Clean and fill cracks	Plan for resurfacing every 5-7 years
Sweep surface clean of debris Roll court if required		Take up lines or weight them if court subject to freeze thaw cycles	Check surface thickness yearly. Re-leveling may be required if court has eroded
Brush surface (more frequently if req'd) Check for tears or loose seams		Clean court surface and apply Apply algicide and fungicide	Plan to replace surface every 8-10 years
		Aerate, dethatch, reseed, and fertilize	
	Water vacuum or water brush surface	Sweep or Blow surface clean Clean and fill cracks and surface tears	Plan for resurfacing every 2-4 years
Brush surface (more frequently if req'd)	Check for tears or loose seams	Clean court surface	Plan to replace surface every 5-7 years
Check net tension and height	Clean Net and Center Strap	Remove nets (or loosen tension) Check cables & replace as req'd., store	
		Remove posts, cap sleeves, lubricate mechanisms, and store	
Check gate swings, lubricate as req'd	Inspect frame, hardware, and footings Repair as required		
Hose down or wash windscreens		Clean, tag locations, remove & store Measure and order replacement panels	Plan to replace every 2-3 years
Check and adjust head alignment and performance, check and clean filters	Adjust timer clocks to changing seasonal water usage requirements	Turn of water supply, drain and blow out system, repair equipment as req'd	If using above ground irrigation, consider converting to subsurface irrigation
Check for nicks or scratches, paint as required to prevent rusting	Check and record light level readings	Clean lenses and check wiring/conduit minimum every 6 months if year round	Replace lamps every 4-5 years
	Check and record light level readings	Clean lenses and check wiring/conduit minimum every 6 months if year round	Replace lamps every 2 years
Check for nicks or scratches, paint as required to prevent rusting		Clean, lubricate, order replacement parts if required, repair, store	
Test emergency back-up system Test Emergency exits	Check perimeter drainage	Clean building, take down, store schedule erection for following year	Plan for fabbric replacement every 10 -12 years
Test emergency exits	Clear gutters, check for any roof leakage	Clean HVAC filters and vents inspect roof and insulation systems	
Inspect courts & surroundings for drainage problems or erosion, repair		Check systems, clear structures and pipes	
Trim grass, sweep walks, check plants for invasive insects or diseases	Change seasonal plantings, fertilize or prune as required	Prune back overgrowth, fertilize plantings, mulch planting beds	

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Hard Court Maintenance

Hard courts include asphalt and concrete tennis courts. Concrete courts may be reinforced concrete or post-tensioned concrete. Most asphalt and concrete courts are surfaced with acrylic coatings.

Pre-Season Maintenance

When reopening asphalt and concrete courts after a cold weather shutdown, the court surface should be cleaned of all debris that has accumulated on the surface. A broom or leaf blower may accomplish this, but more stubborn dirt may require a power washer. Always exercise caution when using a power washer. If the pressure is too high, power equipment can damage the surface system on the court.

If leaves, twigs, grass or other debris have been allowed to stand on the surface of the court, stains may have developed. To remove stains, start with the gentlest treatment. A soft brush and a mild cold water detergent solution may remove the stain. If that doesn't work, try the same brush with a mild chlorine bleach solution — about one cup of bleach to one gallon of water. Don't leave the bleach solution on the court long; it may damage the color coating. If neither detergent nor bleach is successful in removing the stain, contact the court contractor or surface manufacturer for a recommendation. Don't try a stronger cleaning solution without consulting the contractor or the manufacturer.

Tree sap, fruit, dead insects and bird droppings also can stain courts. They should be removed promptly. Once such debris has hardened, stain treatments can be tried, but are likely to be unsuccessful. Prevention is the best option. Trees should not be allowed to overhang courts.

If mold, mildew or algae have appeared in shaded areas on the court, use a bleach solution of 1 part bleach to 5-7 parts water to kill the organism. Allow it to stand on the spot for a few minutes and then rinse the spot thoroughly. Finish the clean up by scrubbing off the growth. Mold and mildew often grow where surfaces are contaminated by food spills, soft drinks or decaying matter, including mold or mildew which has been killed but not cleaned off. Clean acrylic coatings do not support fungus growth.

If any kind of stain has been allowed to remain on the surface for a period of time, natural bleaching of the color coating may have occurred around the stain. Unfortunately, there is no way to correct such bleaching. Do not try to touch up a stain or bleaching by dabbing on leftover surfacing material. Since all courts fade from exposure to the sun, new material applied to touch up a surface blemish will be darker than the existing court surface, leaving the court with a patchy, freckled appearance. If staining or bleaching is severe, recoating the entire court may be required.

Some wear is normal. Color coatings will tend to wear just behind the baseline and, possibly, at the net, depending on the type of use the court receives. Asphalt courts will show some divots, caused by racquets. Some chipping of the acrylic surface on asphalt courts may be evident around the foundations for the net posts, center strap anchor, fence posts or light poles. This is due to the differing rates of expansion and contraction of the concrete foundation and the asphalt court. Finally, some fading of color coatings may be expected. Note wear and keep track of it from year to year to aid in establishing an appropriate maintenance schedule.

Regular Maintenance

Remove all debris which accumulates on the court as soon as possible to prevent staining. Sweep the courts occasionally with a soft brush. Do not use a stiff bristle broom which may damage the court surface. Hose the courts

periodically using normal water pressure. If the court is located in an area where water run off leaves silt or dirt, hose off such residues before they stain or damage the surface.

Spot clean spills as soon as they occur with plain water or, if necessary, a gentle cold water detergent solution and a soft brush, rinsing well after the treatment.

Provide a walk-off mat at the entrance of the court to remove sand, dirt or other abrasive materials from the shoes of players. Abrasive materials will cause premature wearing of the surface coating.

Keep track of the size of cracks in asphalt courts and note any changes. Some cracks may be merely signs of normal wear and tear, while others may signify more serious problems. All asphalt tennis courts crack eventually and once a crack appears, no matter how well it is repaired, it will reappear. Weeds growing through cracks will accelerate their expansion. Use an approved herbicide to prevent regrowth. Most tennis court contractors repair cracks and are experienced in determining the types of cracks and the appropriate methods of repair. Only crack repair materials specifically designed for use on tennis courts should be used. All-purpose fillers, such as those used for driveways, may soften enough during hot weather to be tracked across the court by players, damaging or marring the surface. Other crack fillers may contain polymers of silicon which prevent the adhesion of acrylic surfacing systems.

After a heavy rain, inspect the court. Look for birdbaths, which are defined as depressions where standing water more than 1/16" (2mm) (commonly measured using a nickel) remains after drainage of the area has ceased or after one hour at 70 degrees Fahrenheit (21 degrees Celsius) or above in sunlight. Birdbaths should be repaired by an experienced contractor.

Keep an eye out for bubbles, surface wear, peeling and flaking. Minor surface blemishes may be repaired by patching, but eventually the court will take on a speckled appearance and recoating may be required. For more information on repairs, see Chapter VIII.

Regularly trim the grass and landscaping around the court to permit proper drainage of rainwater from the court surface. Weeds left growing around the perimeter of the court will invade the court surface at its edges. A 2' (610mm) to 5' (1.524m) border around the perimeter should be left free of all vegetation to prevent court damage. Use a commercial herbicide, available from any lawn and garden center, or hand pull weeds to keep them under control.

Winterizing

Prior to closing a hard surface court for the winter, remove all leaves and other debris. Oak leaves, in particular, are acidic and will stain the surface coating if left on the court over an extended period of time. Periodically removing debris over the course of the winter will minimize staining and bleaching.

Do a walk-through of the facility and note any cracks. If possible, repair all cracks before winter sets in. If water settles in a crack and freezes, it will enlarge the crack.

In colder climates, resist the temptation to shovel snow from the court or, if you must remove the snow, shovel very carefully. Shoveling is likely to damage the surface coating. Use a plastic shovel or broom to avoid damaging the surface. Snow left on a court over winter will not damage a properly constructed court. In fact, it will help protect it from the elements. If ice has formed, do not apply salt or attempt to chip it off. Wait for the ice to melt naturally.

Maintenance of Indoor Acrylic Surfaces

Indoor acrylic surfaces accumulate dust, ball fuzz and dirt tracked in by players. Indoor clubs generally maintain a regular schedule of cleaning. Courts should be cleaned by a vacuum or rotary sweeper once a day and cleaned either by water vacuum or water brush unit about once a month.

Indoor courts can show the formation of mold or fungus due to a combination of humidity and temperature along with water and food spills. Fungus should be cleaned with a mild bleach solution of one cup of bleach to one gallon of water and then rinsed. For cleaning curtains, a milder bleach solution is recommended — 1 part bleach to 100 parts water.

Stained courts can be cleaned with a mild cold water detergent and a soft bristle brush.

Hard Court Maintenance Equipment

Water Removal Equipment - Since hard courts are, for the most part, non-porous, it is advisable to have equipment available to help remove surface water after cleaning or after rain. This equipment includes rubber squeegees, foam rollers or water absorbent drums. Rubber squeegees may cause premature wear on the court surface. A foam sponge roller is preferred. Manual equipment is relatively inexpensive. It is a nice touch to have two squeegees or rollers since this speeds drying of the court, extends the life of the equipment and avoids the hard feelings which result when one player rolls while the other watches.

Power blowers are sometimes used for removal of water, leaves and snow. Wet vacuums also can be used for drying courts, as can string mops.

Cleaning Equipment - Large-size push brooms with soft bristles are used for removing leaves and other debris from the court surface. Power blowers, wet/dry vacuums and jet spray cleaners, known as water brooms, also are used for cleaning hard courts. Power equipment will require a 110V outlet. Jet sprayers also will require a hose connection with adequate pressure and volume. Sprayers may be used for cleaning windscreens and divider curtains as well as court surfaces. Care should be exercised when using any pressure-type cleaning equipment since excessive pressure may damage court surfaces, windscreens or curtains.

Fast Dry Court Maintenance

Pre-Season Maintenance

Fast dry type courts should be patched and top dressed at the beginning of each playing season. A single fast dry court can be maintained in prime playing condition by top dressing it annually with approximately 1 1/2 - 2 tons (1361 - 1814kg) of material. In resorts or southern locations where courts are in heavy use year round, top dressing may be required twice a year or more. An owner can take on the task of top dressing; however, since it is a large job, most owners choose to use a qualified tennis court contractor for seasonal maintenance.

Regular top dressing is required because the smallest particles of fast dry material, called "fines," which anchor the larger particles while allowing them to shift enough to cushion the surface, are eroded by heavy play, blown away by the wind or washed away by rain. Applying a new layer of fast dry material by top dressing replaces the surfacing lost during the season so that the surface performs as it did when new. Owners should not wait for noticeable signs of wear before top dressing.

Prior to top dressing, small depressions can be repaired as described under "Regular Maintenance". Larger depressions, which develop due to wear in certain areas of the court, also should be repaired before courts are top dressed. Such depressions are evident after heavy rain and can be marked by encircling puddles with a sharp tool. Another method of locating low areas is by stretching a 20' (6.096m) - 30' (9.144m) string and marking any areas where clearance is evident under the string line. Most depressions are found within an area 6' (1.829m) on either side of the baseline, but some may be found at center court or near the net. Charts and sketches of suspected low areas can be made when courts are closed in the fall for patching in the spring.

It is recommended that the line tapes be removed to facilitate patching and top-dressing. However, in warm weather areas where courts are top-dressed more often than once a year, courts are often top dressed between the lines. Only portions of the tape are removed for patching.

Remove and discard all loose, dead granules from the surface of the court. The material can be swept into piles, using a soft brush or the flat edge of a lute, and removed with a shovel and wheelbarrow. Loose material should not be reused since it no longer contains adequate fines to facilitate bonding. However, a small amount of material may be saved for applying over silty or slippery areas which sometimes appear after rain in problem areas.

When the court is dry, scarify each depressed area to a depth of 1/8" (3mm) using a sharp tool such as the serrated edge of a lute. New fast dry material should be spread and compacted while dry, then leveled to the proper grade. Fast dry material can be leveled using a long straight edge (16' (4.877m) - 20' (6.096m)), a straight 2" (51mm) X 4" (102mm) or a section of aluminum ladder. Water the patch thoroughly. When the area is firm (5-30 minutes), roll it. If time is available, allow 48 hours for additional watering and rolling before continuing top dressing.

On some courts, a thin patch may have a tendency to shift and adhere to the roller. If this happens, discontinue rolling and water the material daily until the old and new material bond. This may take as long as a week or two. However, play may resume during that period.

In areas where the base grade is high and the surface is worn to the extent that the stone subbase is exposed, cut out the remaining surface and stone to a depth of 1" (25mm) below the established grade. Replace the old material with new fast dry material, spreading, compacting and leveling it while dry. Then water and roll the patch. This type of patch should be watered more heavily than a shallower patch. Allow at least 15-30 minutes for the patch to set before rolling with a 600 lb. (272kg) roller.

When top dressing courts, divide the new fast dry material into two parts and apply one-half at a time, watering and rolling one layer before beginning the next. Calcium chloride may be added along with the new material to help the fast dry material retain water. A fertilizer spreader can be used for applying the material. Move first lengthwise, then crosswise, brushing immediately behind the spreader. If a spreader is not available, the material can be spread by hand. Space the bags evenly on the court and spread the material as uniformly as possible with a lute. Brush the court lengthwise, then crosswise to distribute the material evenly. Hand water the top dressed court with a fine spray. Then roll it. Repeat the procedure for the second application. If possible, allow 48 hours after the final rolling before permitting play.

Next, activate and adjust the watering system. If the system incorporates a time clock, set and adjust the clock. Plan on readjusting the time clock throughout the season in response to changing rates of evaporation as the weather warms and cools.

Finally, reinstall the line tapes. Check the condition of the tapes. If they are worn, replace them. Plastic, canvas or synthetic (frequently coated with PVC) tapes are commonly used. Line tapes may be smooth or textured; use of

textured tapes is recommended for consistency of ball bounce and to minimize slipping. When selecting lines, consistency of the bounce, player safety and easy maintenance should be primary considerations.

If using old line tapes, remove the nails prior to reinstalling. Tapes must be tightly secured to minimize tripping hazards. If tapes have not been removed for top dressing, check the nails holding them down, replacing any that are missing and realign the tapes that may have shifted during the down time. The nails used to secure lines should have a head diameter of 1/4" (6mm) - 7/16" (11mm) and may range in length from 2 1/4" (57mm) to 3" (76mm). They may be galvanized steel, aluminum or copper with 2 1/4" (57mm) aluminum being the most widely used. Only copper nails should be used on cinder-based courts since both aluminum and galvanized steel nails will react chemically with the cinders. When installing or reinstalling lines, check carefully to be certain that line tapes are level with the court surface.

Regular Maintenance

Daily maintenance of fast dry courts helps to maintain the quality of the surface, retain the resiliency and reduce the need for patching and repair. Daily maintenance includes brooming (also called brushing or sweeping), watering and rolling. The type and amount of daily maintenance required may be affected by climate and local conditions such as the amount of rain, shade, humidity and wind, as well as by the amount of use the courts receive.

Fast dry courts consist of compacted granules of graduated size which allow air and water to pass through them. The air and water within the court create both the cushioned feel of the court and its cool surface. The purpose of daily maintenance is to keep the fast dry material evenly distributed, to keep the air-water cycle going and to keep the court compacted enough for uniform play.

Broom courts in a continuous pattern to evenly distribute material over the surface. Work first on one side of the net, then on the other. Broom lengthwise one time and crosswise the next. When brooming, the brush should be pulled behind the user. Pushing the brush may create too much pressure, removing fines from the court. The sweeper should try to move continuously, avoiding unnecessary stops and starts which can create small ridges. Finish by sweeping the lines to remove fast dry material.

Remember that brooming dries out the surface of the court and causes the accumulation of dead granules. The more often courts are broomed, the more often those with manual or above surface irrigation systems will require watering. Using the softest bristle brush possible will help minimize problems associated with brooming.

Most modern courts have automatic irrigation systems — either above surface or subsurface. Above surface irrigation systems generally are programmed to come on in the middle of the night. Manually operated systems are usually turned on twice a day, in the early morning and again, if necessary, in the early afternoon. Subsurface irrigation systems keep the courts constantly moist by capillary action. Regardless of the type of irrigation system in use, check the results at least weekly. If the courts aren't properly irrigated, the system may need to be adjusted.

After the surface is watered and the water has been absorbed, the court should be rolled. The degree of compactness depends on player preference. Some court owners roll courts daily. Others roll only once or twice a week, usually after rain. Because the amount of irrigation is constant, courts with subsurface automatic irrigation rarely need rolling. Generally, the firmer a court is maintained, the faster it will play and the less erosion will occur from extended play, wind or heavy rain. After rolling, the lines should be swept to remove the loose fast dry material.

Minor patching can be performed throughout the playing season. Minor depressed areas in the surface are caused by constant scuffing and abrasion during play. The majority of these minor depressions can be prevented or repaired

by brushing as a part of routine daily maintenance. To repair shallow depressions, fill them with new fast dry material, level the area with a straight edge, feather the edges lightly with a soft brush, water and roll the patched area.

In some cases, small depressions become filled with loose, coarse granules creating "dead" spots on the court. To patch them, clean the area of loose granules and fill it with new fast dry material. Compact and level the area, then water it well and roll it. After watering and rolling, the patch should be firm.

Dead material tends to gather under the net on fast dry courts. It should be removed weekly.

Check for wet areas or puddles after a heavy rain to be certain that the court is draining properly. Soft courts are sloped slightly to facilitate drainage. Over the course of the season, particularly if there is a lot of rain, the fines may have a tendency to migrate to the low end of the court, changing the slope and affecting the drainage. Regular brooming helps to redistribute the fines over the court and prevent migration.

Calcium chloride or other court conditioners are sometimes added to fast dry material every 10 days to two weeks to help the material retain moisture. Consult the manufacturer of the specific surfacing material used on the court regarding the use of court conditioners.

Winterizing

No winterizing is necessary for a fast dry surface. The surface will need to be top-dressed, patched and leveled in the spring so any post-season work is unnecessary. Court accessories and equipment, however, do need post-season care.

If line tapes are in good condition, they should be removed when the courts are closed for the winter. Otherwise, it is likely that frost will heave them out of the ground over the winter. Nails should be removed and the tapes cleaned or painted and rolled for storage. Many owners opt to replace tapes annually rather than reconditioning and storing them.

In variable climates, where courts may be playable during part of the winter, roll the tapes into the court with a hand roller when the courts are frozen. Another option is to cover the playing lines with boards to help keep them in place. Bricks or small blocks may add some weight to hold the boards in place. The tapes may not be perfect, but the courts will be playable over winter or in early spring prior to reconditioning.

All water lines for above surface or subsurface irrigation should be drained except those below the frost line. Pressurized air will remove all water remaining in the pipe system. Broken or malfunctioning sprinkler heads on above surface irrigation systems should be removed for repair or replacement.

Post-season repair and proper storage of court maintenance equipment will prolong its life. Rollers, for example, should be thoroughly cleaned and lubricated. Lubricating them thoroughly before storing them will prevent them from rusting or freezing up. The engine oil and transmission fluid in power rollers should be changed so that they are ready for operation in the spring. Water-ballast rollers should be drained or antifreeze should be added to the drums to keep them from freezing up and bulging.

Clay Court Maintenance

Pre-Season Maintenance

The difficulty, or ease, of maintenance and the general condition of clay courts throughout the year largely depends on the quality of pre-season maintenance. First, a court should be allowed to dry. Then, it should be rolled, once in each direction. A filled or partially filled water-ballast roller, 30" (762mm) in diameter and 36" wide (914mm), a 1,000 lb. 4' (1.219m) roller or a similar lightweight roller is recommended for this purpose. Next, the rolled surface should be scratched up with an iron rake or scarifier to a depth of at least 1/2" (127mm). Then, the loosened clay should be raked with a leaf rake to remove any stones.

Once the old surface is prepared, approximately 10 cubic yards of finely screened clay should be spread over the surface of each court. This amount should yield a coating of about 1/2" (127mm) of new material. Clay suitable for tennis courts is thick and putty-like. Clay which crumbles or powders will require more frequent watering.

When the new layer of clay is in place, the surface should be dragged with a mat to spread the top dressing into all the small depressions. Then, it should be rolled once in each direction with a heavier roller. The surface is then sprinkled and allowed to dry, after which the process is repeated until the surface is smooth, hard and uniform. Just prior to the last rolling, a thin dressing of clean sharp sand may be added over the surface.

As an alternative, clay courts may be top dressed with crushed red brick or green slate, stone or rock material. Brick chips, in particular, make an economical and attractive surface. Brick chips are made of crushed red brick or tile fired to about 2,000° Fahrenheit. Unlike stone dust or screenings, brick chips will absorb water and will add some drying quality, as well as color, to the clay court. The exact proportion of brick chips to clay will depend on the amount of sand or silt already present in the clay.

Several types of mechanical hand propelled markers are available for marking clay courts. These are designed for use with either a wet marker or a powder marker. One method commonly used is to mark the court with linseed oil. After the oil has dried for at least 24 hours, the lines are then painted with white traffic paint. Such lines are quite durable. Synthetic line tapes, such as those used on fast dry courts, also can be used on clay courts.

Resurfacing with Fast Dry Material

Clay courts can be resurfaced with fast dry material if a complete resurfacing is undertaken or improved by the addition of fast dry material without chemical binder. Consult a local contractor with fast dry experience or a manufacturer for specific suggestions.

For top dressing with fast dry material, add material in one ton increments, up to a total of five tons. To install, first scarify the clay surface 1/2" deep (127mm) and then drag it smooth. Next, spread the fast dry material evenly over the surface of the clay and mix it thoroughly using a rake or scarifier. Roll well. Add additional increments of fast dry material, one ton at a time, mixing and rolling each additional layer. Once this process is completed, apply 200 - 400 lbs. of flake calcium chloride, water and roll well. A clay court top dressed with fast dry becomes available more quickly in the spring since the fast dry material protects the clay. This hybrid court surface can be rolled while damp and, often, scarifying is unnecessary.

For resurfacing clay courts with fast dry material, consider first whether or not to remove the clay. Removing the clay and installing a new fast dry surface on the base of crushed stone provides the best playing surface but is more expensive than the alternative of installing new material on top of the clay.

Regular Maintenance

The uniformity of the playing surface and the availability of clay courts after a rain is dependent on regular maintenance. Maintenance may include brooming, watering and rolling. The type and amount of daily maintenance required will be determined by climate and local conditions such as the amount of rain, shade, humidity and wind, by the amount of use the courts receive and by the type of clay and/or top dressing used.

Soft Court Maintenance Equipment

Irrigation Systems -

Fast dry and clay courts require regular irrigation.: During especially hot weather, courts may require watering several times a day. Courts may be hand watered with a hose or watered with conventional sprinklers. Because of the labor cost involved in hand watering, however, most courts are equipped with either above surface or subsurface irrigation systems.

Above Surface Irrigation Systems

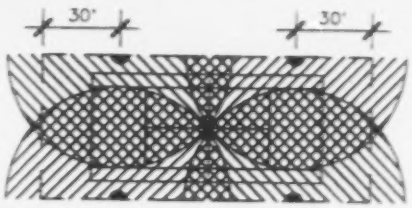
Above surface irrigation systems consist of water lines connected to sprinkler heads. There are a number of brands and models of sprinkler heads available: impact sprinklers, gear driven sprinklers, full circle sprinklers, part circle sprinklers and pop-up sprinklers. Some types are suitable for installation on the perimeter of the court only; others are suitable for installation on the court surface. Water pressure, water volume, sprinkler radius, friction loss, prevailing winds and other environmental conditions will affect the design of a suitable layout for an above surface irrigation system and the type or types of sprinkler heads to be used.

Water lines must be chosen to supply sufficient volume to each sprinkler head to provide adequate coverage. Galvanized steel, copper, polyethylene or PVC pipe can be used for water lines. In designing any above surface irrigation system, caution should be exercised in determining the location, elevation and type(s) of sprinkler heads to minimize any potential hazard to players.

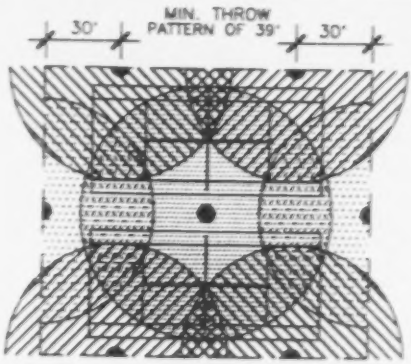
Most above surface irrigation systems are connected to timers which automatically turn the sprinklers on and off. Multiple irrigation cycles may provide more efficient use of water since shorter more frequent cycles will allow gradual absorption of water into the surface and base. Zoning certain areas of the court and watering them more or less frequently may also result in more efficient and uniform coverage. Shaded areas or areas along the low side of the court may require less water than sunny or high side areas.

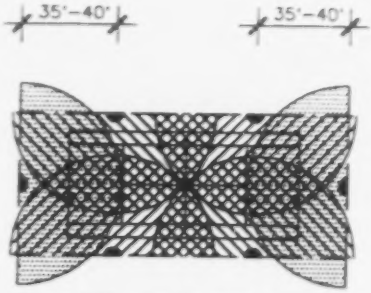
Subsurface Irrigation Systems

A number of proprietary subsurface irrigation systems are available. Subsurface irrigation systems are designed to provide consistent, uniform moist surfaces. Most systems consist of a moisture barrier or liner, a water source and a moisture control system to allow for regulation of water in the court depending on environmental conditions, rainfall, etc. The subsurface irrigation system may be controlled by water level floats, timers or solenoid valves. Moisture moves through the court from the subbase to the surface through capillary action. While initially more expensive, subsurface irrigation systems will reduce maintenance costs and down time, resulting in cost savings over time. System manufacturers estimate payback in five years or less.

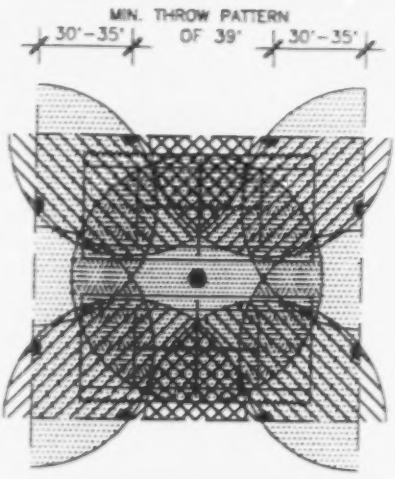


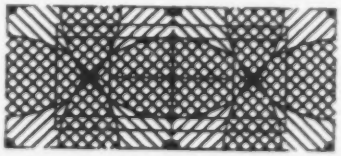
IDEAL WHERE NO WIND PROBLEMS EXIST AND ADEQUATE PRESSURE AND VOLUME CAN ACHIEVE A MINIMUM THROW PATTERN OF 43'





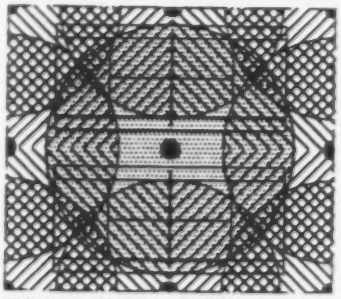
GOOD WHEN CONDITIONS ARE LESS THAN PERFECT. WORKS WHEN ADEQUATE PRESSURE AND VOLUME CAN ACHIEVE A MINIMUM THROW PATTERN OF 39' (36' AT 40') CAUTION: REAR SPRINKLER BEHIND BASE LINE COULD BE A SAFETY HAZARD.





CONFIGURATION PROVIDES EXCELLENT COVERAGE BUT USUALLY REQUIRES A HIGHER VOLUME SOURCE UNLESS THE SYSTEM IS ZONED. REQUIRES ADEQUATE PRESSURE AND VOLUME TO ACHIEVE A MINIMUM THROW PATTERN OF 43'

SINGLE COURT



MINIMUM THROW PATTERN OF 43'

MULTIPLE COURTS

TYPICAL SURFACE IRRIGATION SYSTEM LAYOUT PLANS

NOT TO SCALE

IRRIG

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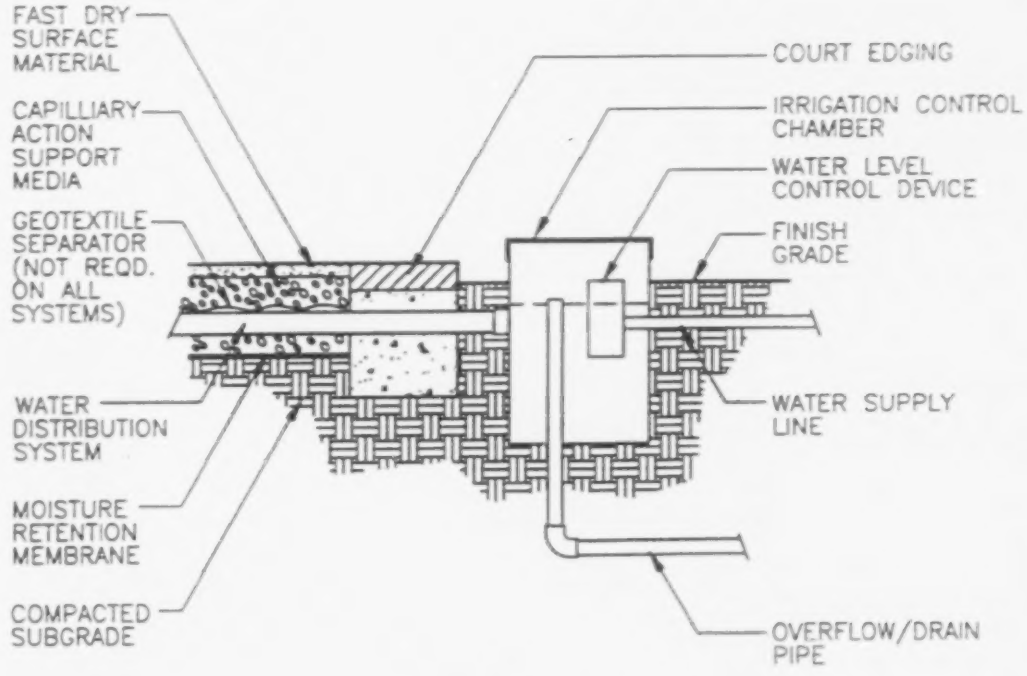
NOTES:

PORTIONS OF THE TECHNOLOGY ILLUSTRATED IN THIS DRAWING ARE PROTECTED UNDER U.S. PATENTS.

CONTACT A SUBSURFACE IRRIGATION SYSTEM MANUFACTURER FOR SPECIFIC DESIGN AND CONSTRUCTION REQUIREMENTS.



SCHEMATIC DIAGRAM OF FAST DRY COURT SUBSURFACE IRRIGATION SYSTEM

NOT TO SCALE

IRRIG2

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Rollers

Soft courts need to be rolled periodically to keep the surface uniformly compacted. Rollers include power rollers, in gas and electric models, which may help make the job easier, but which will require maintenance and, if electric, a power source. Also available are water-filled hand rollers. Rollers vary in width from 24" (610mm) - 72" (1.829m). The size and type of roller required will depend on the number of courts; large batteries of courts will require larger rollers or power rollers to make the job manageable. When designing courts, plan storage, paths and gates to accommodate appropriate rollers. In the case of very large facilities, utility carts may be required to transport large rollers from battery to battery.

For large facilities, brush-roller combinations can reduce maintenance time by performing two operations at once. However, caution should be exercised in using brush-rollers since the brush treats each area of the court the same whereas hand brooming allows more or less pressure to be applied as appropriate.

Small diameter (18" (457mm)) hand rollers are useful for patching low areas.

Drag Brushes, Brooms and Line Sweepers

Court brushes and brooms need to be readily available and, therefore, are usually hung on the fence. Since these items are exposed to weathering, weather resistance and durability are key factors in choosing this equipment. Lightweight equipment also is preferred since it is easier to use.

Brushes are used after play and before rolling to evenly distribute loose material over the court surface. They come in both hand and tow types. The most commonly used brush is a drag brush 7' (2.134m) in length, but brushes vary from 5' (1.524m) - 7' (2.134m).

A soft bristle push broom approximately 18" (457mm) wide should be used for smoothing areas which have been lightly scuffed or for finishing after dragging or rolling. Smaller brooms, such as household brooms, can be used for sweeping line tapes, but special line sweepers, consisting of a long handle attached to an axle with a circular brush between two small wheels, accomplish the task more quickly.

All brooms and brushes should be designed for easy replacement of parts. Brushes, brooms and line sweepers should be hung when not in use, never rested on their bristles.

Scarifiers

These tools, sometimes known as lutes or lute scarifiers, scratch and loosen the court surface, a process called scarifying. They are used to loosen old material for removal prior to reconditioning or prior to patching low areas in the court surface. Scarifying the surface prior to patching helps to strengthen bonding between layers of a court surface. Scarifiers, or lutes, also are used in top dressing courts. Power scarifiers are available, but special iron rakes may be used for this purpose as well.

Spreaders

Spreaders are used for the application of top dressing and court conditioners. They come in drop bottom and broadcast varieties, in hand and tow models, and in fixed rate or variable rate applications. The drop bottom type is generally considered to provide a more uniform application with less dust. There are models in widths from 30" (762mm) to 6' (1.829m).

Line Tapes and Nails

Line marking tapes should be of waterproof material. Generally, plastic, canvas or synthetics are used. They should have a rough texture to give traction to shoes and to minimize ball skid. Nails, used to affix tapes to the court, are made of galvanized steel, copper, or most commonly, aluminum. Copper nails should be used on cinder-based courts because such courts react chemically with aluminum and galvanized steel.

While it is tempting to store court maintenance equipment such as brooms or rollers by hanging them on the fence within the court enclosure, the benefits of this convenience should be weighed against any possible hazard to players who accidentally run into them. For this reason, it is recommended that consideration be given to storing such equipment outside of the court enclosure.

Grass Court Maintenance

Pre-Season Maintenance

Begin preparing the courts for play in early spring or as soon as the weather permits. The most important operation in the spring is rolling. Rolling helps to cure any heaving caused by frost damage. Begin with a light roller, perhaps 2,240 lbs. (1,016kg). Roll frequently, gradually increasing the weight of the roller to 4,480 lbs. (2,032kg). Gradually increasing the weight of the roller compacts the soil without damaging the soil structure or the grass roots. For the proper surface for play, the soil must be quite compact to a depth of at least 4" (102mm). Do not roll when the court is wet as it can cause ridging.

Continue mowing gradually decreasing the height of the grass from 1/2" (13mm) to 3/8" (10mm) to 5/16" (8mm) when play begins and 1/4" (6mm) for tournaments. The optimal turf height will depend on the grass species.

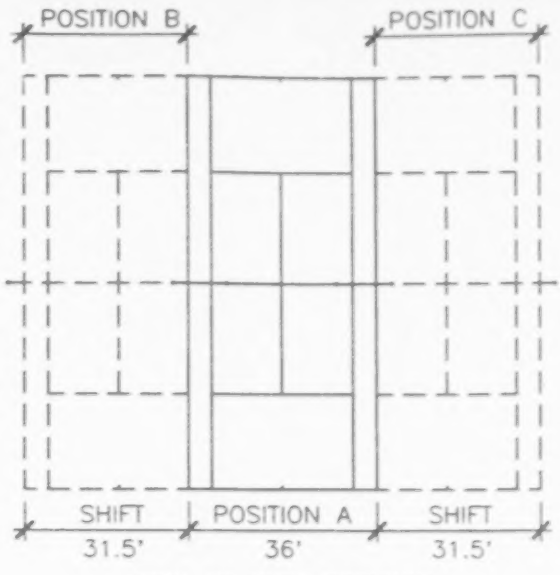
Fertilize the courts in spring. Balancing the needs of players with the needs of the turf is a constant effort. Fertilizing is a good example of this balance. Ideally, the grass should be bright green. Nitrogen is required to give the grass a good green color. However, add too much nitrogen and the grass will be so lush that it will become slippery. Apply fertilizers early so that the grass will be healthy, but not so lush as to provide a poor playing surface.

Mark out courts with a string line. A spray system or a wheel marker can be used to mark lines. The common mixture is a titanium-based marking compound with china clay, diluted with water. This solution will last a few days, even with heavy play. Another alternative is to spray lines with white latex paint. These lines remain until the grass grows out and the paint is removed by mowing.

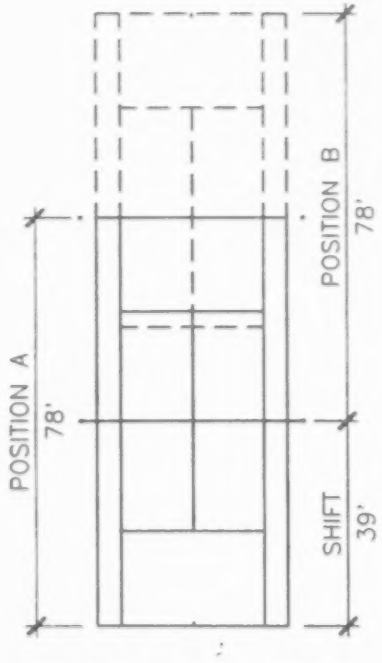
To prevent excessive wear, the location of grass courts is often rotated on a site. A regular rotation plan insures the health of the turf and optimum play.

Regular Maintenance

Regular mowing and water management is required for optimum grass court play. Ideally, the courts should be quite dry. The grass must be watered enough to keep it strong and healthy, but not so much as to make it too lush or to make the soil too soft. Courts are most often mowed lengthwise and, occasionally, crosswise to ensure an even growth pattern. They are rolled frequently and remarked every few days. At first class clubs, courts may be mowed, rolled and marked daily.



SIDE TO SIDE ROTATION



FRONT TO BACK ROTATION

RECOMMENDED ONE COURT AREA REQUIREMENTS:

SIDE TO SIDE ROTATION	123' X 120'
FRONT TO BACK ROTATION	60' X 159'
ROTATION IN BOTH DIRECTIONS	123' X 159'

NOTE: ROTATION IN BOTH DIRECTIONS IS PREFERRED TO MINIMIZE TURF WEAR & DAMAGE

TYPICAL GRASS COURT PLAYING LINE ROTATION PATTERNS

NOT TO SCALE

GRASS – 2

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202

Winterizing

Unlike most types of courts which are renovated in the spring, the major season for renovating grass courts is fall. By the end of the playing season, the concentrated play areas on the courts can be quite bare. Because they may be worn, especially at the baseline and at the check area where players stop coming off the serve, and because they may have been kept dry for play for a long time, grass courts can look quite bad at the end of the season. Well-maintained courts with strong soil and healthy root growth will still play well, but fall is the time to do the work which will ensure that the soil and grass will be ready for the next season.

Begin by irrigating. To renovate without destroying the root growth or soil structure, the soil must be thoroughly moist to a depth of at least 6" (152mm).

Next, aerate the soil. The courts will have been compacted by rolling throughout the season. Healthy grass will continue to grow, but to survive and thrive over winter it will need more air in the soil. Grass needs at least 10% air volume in soil spaces for healthy growth. In addition, air is necessary for the bacteria which break down fertilizers, thatch and mat. Courts can be aerated manually with a long-tined garden fork. The proper motion is to push down and lift forward slightly. The goal is not just to make holes in the soil but to crack the compacted soil and loosen it. To prevent damage to the soil structure, however, the soil must be moist during aeration. If the court is especially compacted, hollow coring provides even more aeration. In this process, manual or power tools remove small cores, break up the cores and redeposit the soil on the top as top dressing. The court should be gone over with either an aerating tool or a hollow corer at least 2-3 times.

Following aeration, the court should be de-thatched. A scarifier, such as those used on fast dry courts, can be used as can de-thatching tools and machines manufactured specifically for this purpose. Depending on the amount of thatch which has developed, the court should be de-thatched from 4-10 times, removing up to one ton (907kg) of material per court. Brushing the court with a stiff bristled brush between de-thatching operations will facilitate removal of dead material. After de-thatching, the court will look quite bare. Finish cleaning the court by mowing to a depth of 1/4" (6mm).

Next, re-seed the court. A broadcast spreader is preferred to a drop bottom model since the drop bottom seeder tends to leave straight lines in the surface. A thick application of seed should be applied — approximately 20 lbs. (9kg) per 1,000 square feet (93m2) — in two or three perpendicular passes. The seed mixture chosen should be appropriate for the climate and for the anticipated mowing height for play in the following year. Golf course superintendents may be a good source of information on seed mixtures.

Treat stress areas with additional seed. Then, top dress the entire court with manufactured soil, brushing it in. Irrigate and leave the court resting for germination. Frequent light irrigation is required to ensure germination.

Once the grass has reached a height of 1/2" (13mm), mowing should begin. Continue mowing throughout the winter to a height of 1/2" (13mm).

When the new grass is well-established, top dress with soil at a rate of 2 (1,814 kg) -2 1/2 tons (2,268kg) per court, brushing it well into the surface with a drag mat. When the top dressing has weathered into the surface, complete other operations such as fertilizing or applying fungicide as required. Apply iron a little later in the year. Iron toughens the turf, makes it resistant to disease and gives it good color.

Grass Court Maintenance Equipment

Grass court maintenance equipment includes aerators, rollers, de-thatchers, mowers, spreaders, scarifiers and brushes.

Sand-Filled Turf Court Maintenance

Pre-Season Maintenance

Prior to opening the court for the season, do a "walk through" of the facility. Look for standing water. Wet turf presents a slipping hazard and promotes the growth of algae. If the court isn't level or if it isn't draining properly, consult a professional contractor for an evaluation.

Check the playing lines, which may be dirty or faded. Cleaning with a manufacturer-approved cleaning solution and a soft brush or with a power broom can restore color to the lines.

Examine the surface carefully for any signs of seam splitting or lifting. Seam splitting or lifting should be repaired as soon as it is discovered. Inevitably, it will worsen, creating a larger repair problem as well as a player hazard. Contact a contractor immediately.

Regular Maintenance

The goal of regular synthetic turf maintenance is to distribute sand consistently over the court surface and to keep the turf fibers standing up. When a court is first installed, weekly brooming against the direction of any fiber lean is required. If the weather is particularly dry, periodic watering of a new court will assist in compacting the sand uniformly. After the break-in period, weekly heavy brooming for club courts and heavy brooming once every six weeks for residential courts is usually sufficient to keep the sand uniformly distributed, while weekly light brooming will help to keep the turf fibers erect.

After a court is installed, the fine sand particles tend to migrate downward through the turf, leaving the coarser particles on top. These larger particles can make a court slippery. Replacing lost sand and grooming the court will bring it back into playing condition. The turf fibers should be exposed 1/16" (2mm) - 1/8" (3mm). Remove excess sand from high spots and add it to low spots. When adding sand, brush it into the synthetic turf in layers, brushing the carpet pile up as layers are completed.

Remove debris including leaves, pine needles and other tree droppings regularly using a leaf rake and a shovel, a leaf collector or a power blower. Exercise care when using a power blower. Too much power or using the blower too close to the surface may blow the sand, creating a non-uniform surface.

Ensure that drainage systems are clean and functional. Do not allow water to seep under or run onto the surface. After a heavy downpour, bubbles may develop on the surface. A bubble means that water has managed to enter under the carpet and cannot escape. Stick a sharp implement such as a knife through the carpet on the low side of the bubble. Make a slit, not a hole. Limit the size of the slit to no more than 1/4" (6mm). Water will slowly drain out and the carpet will return to its original shape. Once a bubble has been slit, the problem will not recur.

In shaded areas, algae may grow on turf surfaces. Salt will kill surface algae. Simply water the area and spread the salt over the algae. Within a few days, the algae should die and turn brown. An alternate treatment is a mild bleach-water solution (one cup of chlorine bleach for each gallon of water used). Allow the bleach solution to stand

for a few minutes, then rinse it thoroughly and allow the area to dry. Brushing with a stiff broom or scrub brush will remove the dead remains of the algae. If dead material is not removed, algae growth will recur. Plan on treating algae-prone areas on a regular basis. Check with the turf manufacturer before applying a more powerful algicide. Some algae and/or fungus only can be removed by power brooming and replacing infected sand.

To prevent maintenance problems, require players to clean their shoes before entering the court. No food or drink, except water, should be allowed on the court surface. Any spill should be cleaned immediately with plain water or a diluted cleaner and rinsed thoroughly.

Absolutely no smoking should be permitted in the court area. Burnt areas on the carpet are unsightly. For superficial burns, the carpet pile can be carefully clipped below the blackened or melted tips. For larger burns, the area may need to be replaced and patched. Contact the contractor for assistance.

Winterizing

Remove all debris from the court surface. Check the edges of the court to make certain that no debris is obstructing drainage. Apply an algicide recommended by the surface manufacturer to the entire court surface to help retard the growth of any fungus, mold or mildew during the winter. Check the court periodically over winter to ensure that no water is standing on the court. Since it is likely that the sand in the synthetic turf surface will shift during winter weathering, redistributing the sand at the end of the season is unnecessary.

Sand-Filled Turf Court Maintenance Equipment

Drag brushes and spreaders, such as those used with soft courts, also are used in the maintenance of sand-filled synthetic turf courts. Turf courts require stiff drag brushes to keep the sand evenly distributed over the surface of the court. Spreaders are used during installation to distribute sand through the synthetic turf and for reconditioning. Debris-removers, made specifically for sand-filled turf courts, remove leaves, sticks and other debris using rotating brushes without removing the sand from the surface.

Net Maintenance

Installing a Tennis Net

First, connect one end of the net cable to the post cable hook on the net post without the winding mechanism, commonly called the dead end or anchor post.

Then lead the cable over to the opposite post and connect it to the winding mechanism. Almost all nets have 2 1/2" (64mm) - 3" (76mm) loops in both ends. When installing the net, one of these loops may have to be removed, depending on the type of post winding system used. Vinyl coating on the cable, if any, should be removed in the area of attachment to the winder.

Turn the winding mechanism to raise the net to a height of slightly over 3' (914mm) at the center. Do not over tension the net cable. Modern net cables have extremely high breaking strengths and it is possible to bend the posts by over tensioning the net.

Insert dowels into the sleeves provided in the net's side bindings, if they are included with the net.

Install the lacing cord by looping it through the grommets in the side bindings of the net and pulling the net very close to the lacing bars on the net posts or to the posts themselves if no lacing bars are provided. Continue lacing down the net and tie off the lacing cord at the bottom. Repeat this procedure at the other post. Proper lacing should insure that the net is taut and flush with the inside edge of each post.

Check net tautness by suspending a 24 lb. (10.9kg) weight from the center of a singles net or a 14 lb. (6.36kg) weight from the center of a doubles net and wind the net slowly to a center height of 36" (914mm). Install the center strap and adjust it to maintain the height of 36" (914mm). Remove the weight. This method produces a net cable tautness of approximately 500 - 550 lbs. (227 - 250kg)

When a weight is not available, net height is commonly adjusted by winding the net to a height of about 3' 4" (1.016m) at the center and using the center strap to pull the net down to 36" (914mm). This method is not recommended, however, since it may result in significant tautness variations from court to court. Variations in net tautness affect the play of let balls. At net cable tensions below 350 lbs. (159kg), much of the let ball's energy is absorbed by the net cable and action of the ball is unpredictable. The ball tends to "bloop" down on either side of the net. At a net cable tension of 500 lbs. (227kg), however, the let ball either is deflected back into the near court or goes over the net in a playable fashion, depending on the quality of the shot. In other words, with proper net tension, action of let balls becomes consistent and playable. Equally important, adjusting net tension by the height method may encourage over tensioning of the net, resulting in excessive strain on net posts and their footings.

Net Maintenance

Repair tears as soon as they occur. Clean the headband as necessary with a mild household cleaner. If necessary, replacement cables are available, as are replacement headbands.

When winterizing courts, loosen the net cable and center strap prior to closing the court. In winter and spring, the subbase becomes saturated with water. This saturation weakens the support around the footings making the net posts susceptible to leaning when under excessive pressure. In milder climates where an occasional sunny spell may draw players outside for a midwinter match, they will need only to re-tension the net to play. In such variable climates, check the nets periodically, and loosen the cables again if necessary. Another option is to use a winter net. When replacing a net, save the old net and put it up for the winter, storing the new net for use during the principal playing season.

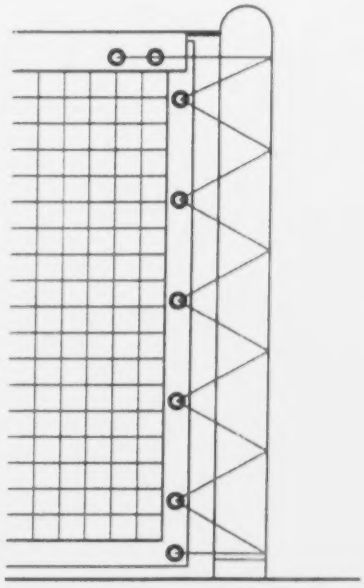
In areas with extremely cold and inclement weather throughout the winter, removing the net, as well as the posts (if they are installed in sleeves), and putting them into storage for the season may prolong their useful life. If posts are removed, be certain to plug or cap the sleeve holes to prevent water and debris from entering the sleeves.

Net Post Maintenance

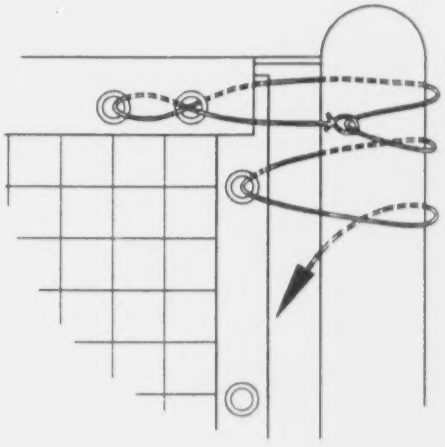
Never over tension the net cable. Where courts are staffed or maintained on a regular basis, net posts with removable handles may help insure that only those persons who understand proper net tensioning tighten the cable.

Keep net posts clean and touch up nicks and scratches on coated posts as soon as they occur to prevent rust. Use lubricating oil on the winding gear mechanism and sheaves. Lithium-based gear lubricant, available for marine use, has the advantage of lasting a season.

External winding mechanisms, if broken, are easily replaced. Broken internal mechanisms, however, usually require replacement of the entire gear assembly within the posts.



TYPICAL ELEVATION OF A PROPERLY LACED NET



NET LACING DIAGRAM

TYPICAL NET LACING DIAGRAM

NOT TO SCALE

NET – ELV2

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207

Old-style lever-action posts should be removed and replaced. They constitute a hazard to players. Until these posts are replaced, insure that the lever is locked or chained in a closed position.

Bent posts should be replaced. If the posts are set in sleeves, this is a simple procedure. If, however, the posts are permanently fixed in footings, the entire post footing will need to be excavated and reinstalled along with the new posts.

When winterizing courts, remove rods, handles and eyebolts which may be stolen or vandalized during the winter.

Posts set in sleeves may be removed, painted and stored for the winter. The empty sleeve should be covered with a cap to keep it clean and to prevent water from settling in the sleeve and damaging it with rust and corrosion.

Lighting Maintenance

When a new lighting system is installed, turn it on and allow it to burn continuously for 100 hours. During that time, the color will stabilize. Typically, any equipment failure which is likely to occur will occur within that period. Any problems identified during that initial period should be repaired by the installer. After the 100-hour period, using a light meter, measure horizontal illumination 36" (914mm) above the court surface at various points on the surface. Compare findings with the measurements provided on the point-by-point lighting plan. Visually inspect each fixture for proper aiming and light output.

Frequent turning on and off will decrease lamp life in HID and quartz lamps. On the other hand, turning lamps off when courts are not in use will result in savings on the cost of electricity. As a compromise, if the lights are turned off any time the court will not be in use for a period of two hours or more, the savings in electricity will generally offset any reduced lamp life.

Measure the light levels over the court surface every six months. This will help determine when fixtures should be cleaned and/or when lamps should be replaced. Cleaning fixtures will help extend useful lamp life, since dust and dirt cut down on the light output of lamps and reduce the effectiveness of reflectors. When cleaning fixtures, do not use a dry cloth since this creates static electricity which will cause lamps to collect dust again more quickly. Wipe lenses, louvers and fixtures with a damp cloth dipped in cleaning solution and rinse them with a damp cloth dipped in water. Allow them to dry without wiping to avoid streaking.

Cleaning all fixtures and replacing all lamps at one time may reduce maintenance costs. Using experience and taking into consideration the manufacturer's average lamp life, it will be possible to determine an appropriate schedule. Indoors, plan on cleaning fixtures and replacing all lamps about every six months. Many lighting system installers will offer this service under a maintenance contract.

Touch up any nicks or scratches on coated surfaces on poles and fixtures as soon as they occur.

Windscreen Maintenance

Measuring for Windscreens

Begin measuring at a terminal post (corner) and continue to the next terminal post. Pull the tape tautly. Measure from the fence fabric side of the tension bar on one side to the fence fabric side of the tension bar on the other.

Depending upon the type of hardware which will be used to attach the windscreens, subtract up to 4" (102mm) to insure a tight fit. The fit also will depend on the type of fabric being installed since some materials tend to stretch more than others. Consult your windscreen manufacturer for guidance.

Disregard line posts (which should be outside the fence). Remember the windscreen should cover the fence fabric, not the terminal posts.

Mark each measurement on a diagram of the court. This diagram will be helpful later in removing, storing and rehanging windscreens. Standard pre-fabricated windscreen lengths are 60' (18.288m). For custom windscreens, exact measurements are necessary, including feet and inches. Do not round off. No two fence configurations are identical.

The width of gates should be measured from the inside of the tension bar on one side to the inside of the tension bar on the other. The height of the gate should be measured from the bottom of the top rail to a point at the bottom where the panel should end on a line with the windscreen on the adjoining fence. Remember, windscreens often are installed 1' (305mm) - 2' (610mm) up from the bottom of the fencing and the windscreen on gates should be installed at the same height for a neat appearance.

The width of the transom should be measured from the inside of the tension bar on one side to the inside of the tension bar on the other, subtracting up to 4" (102mm) depending upon the type of attachment and on the type of fabric. The height should be measured from the bottom of the top rail to the top of the bottom rail, again subtracting the appropriate amount. The top of the windscreen should be on a line with the adjoining windscreen to present a neat, workmanlike appearance.

Installing Windscreens

New screens or properly stored screens should be tagged as to size and should come with a diagram for installation. Begin at one corner and move around the court.

If windscreens are not tagged, remember the following:

1) The back of most courts is approximately 55' (16.764m) - 60' (18.288m), depending on the configuration of the bank.

2) The long side of the court is approximately 115' (35.052m) - 120' (36.576m). This will normally be divided into two pieces of windscreen 55' (16.764m) - 60' (18.288m).

3) If time is available, measure all lengths of screen and make a diagram of the court, indicating where the sections will be installed.

4) Otherwise, identify all identical sections. Then gather all gate, transom and other unusual pieces and position them on the court. Fill in the gaps with the standard length pieces.

Six foot (1.829m) and 7' (2.134m) windscreens usually are installed in the center of the fence. Since the standard fence is 10' (3.048m) high, the windscreen will be 1 1/2' (457mm) - 2' (610mm) down from the top and 1 1/2'

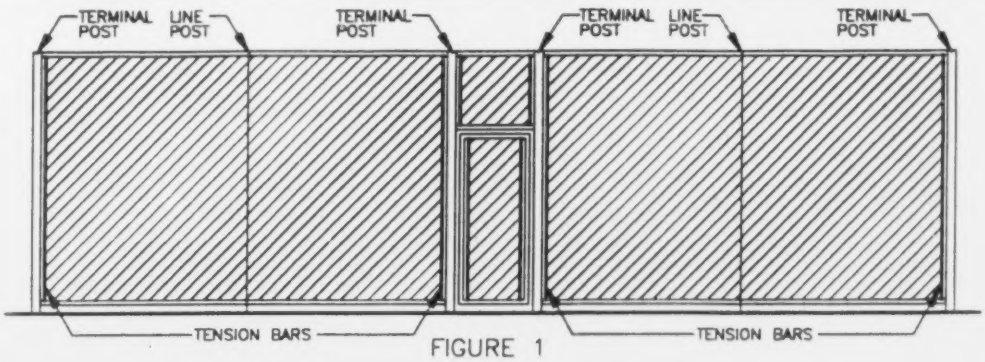

FIGURE 1

1. MAKE SURE THAT YOU BEGIN MEASUREMENT AT A TERMINAL (CORNER) POST AND CONTINUE TO THE NEXT TERMINAL POST. (SEE FIGURE 1) DO NOT HOLD THE MEASURING TAPE UP TO THE FENCE. THIS WILL CREATE SLACK WHICH COULD CAUSE MEASUREMENTS TO BE TOO LONG.
2. MEASURE WINDSCREEN LENGTH FROM INSIDE TENSION BAR TO INSIDE TENSION BAR. YOU MAY DISREGARD LINE POSTS UNLESS THEY ARE ON THE COURT SIDE OF THE FENCE. FOR EASE OF HANDLING, WINDSCREENS SHOULD NOT EXCEED 60'–70' LENGTH.
3. MEASURE WINDSCREEN HEIGHT FROM BOTTOM OF THE TOP RAIL TO THE TOP OF BOTTOM RAIL. YOU MAY WANT TO TAKE INTO CONSIDERATION THAT WINDSCREEN IS GENERALLY INSTALLED ONE OR MORE FEET FROM THE TOP AND BOTTOM OF THE FENCE.
4. MARK EACH MEASUREMENT ON A DIAGRAM OF EACH COURT. SEND A COPY OF THIS DIAGRAM TO THE WINDSCREEN MANUFACTURER WHEN YOU PLACE YOUR ORDER SO THAT EACH WINDSCREEN WILL BE PROPERLY LABELED WHEN IT IS SHIPPED TO YOU. ALSO BE SURE TO TAG EACH PANEL BEFORE YOU REMOVE YOUR WINDSCREEN FOR STORAGE EACH YEAR.
5. EXACT MEASUREMENTS ARE NECESSARY(INCLUDING FEET AND INCHES). DO NOT GUESS OR ROUND OFF DIMENSIONS. NO TWO FENCES ARE IDENTICAL.

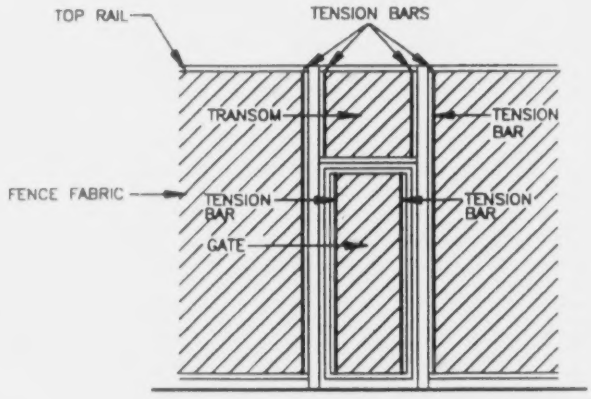

FIGURE 2

1. THE WIDTH OF THE GATE (SEE FIGURE 2) SHOULD BE MEASURED FROM INSIDE TENSION BAR TO INSIDE TENSION BAR. THE HEIGHT OF THE GATE SHOULD BE MEASURED FROM THE BOTTOM OF THE TOP RAIL TO THE TOP OF THE BOTTOM RAIL. YOU MAY WANT TO TAKE INTO CONSIDERATION THAT WINDSCREEN IS GENERALLY INSTALLED ONE OR MORE FEET FROM THE BOTTOM OF THE FENCE.
2. THE WIDTH OF THE TRANSOM (SEE FIGURE 2) SHOULD BE MEASURED FROM INSIDE TENSION BAR TO INSIDE TENSION BAR. THE HEIGHT SHOULD BE MEASURED FROM THE BOTTOM OF THE TOP RAIL TO THE TOP OF THE RAIL OVER THE GATE OPENING.

WINDSCREEN MEASUREMENT DIAGRAM

NOT TO SCALE

WSCRN – 1

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(457mm) - 2' (610mm) up from the bottom of the fence. Nine foot (2.743m) windscreens are hung from the top of the fence. On the standard 10' (3.048m) fence, this will leave 1' (305mm) of space at the bottom. At least some space above and/or below the windscreen is desirable for ventilation.

Always hang the windscreen so that the seams and hems are toward the fence and the smooth side faces the court.

First, fasten one top corner. Then, fasten the screen across the top, keeping it straight. Next, fasten the bottom, pulling the screen tight. Fasten the ends last. Be certain to use all grommets to affix the windscreen to the fence. If a grommeted center tape is used, lace it after the windscreen is attached. If plastic tie wraps are used, cut off any sharp, exposed ends to prevent player injury.

There are at least four acceptable ways of attaching a windscreen: 1) "S" hooks or hog rings (a kind of "C" hook) are strong and durable, but hard to use and cause wear to the fence. Once crimped closed, both "S" hooks and hog rings are quite difficult to remove. Therefore, they are normally used for permanent installation of screening in areas where courts are used year-round and where little wind is anticipated. The permanent installation of windscreens, using "S" hooks or hog rings, does not allow windscreens to be removed easily, even when strong storms are predicted. Most windscreen manufacturers, therefore, no longer recommend their use. 2) Where screens are put up only during playing season and removed for storage during the winter or where they may need to be removed during storms, lacing cord gives a neat appearance and is easy to use. Cord takes longer to install than some other systems, but is quick to remove and often reusable. Lacing windscreens all around gives a particularly neat and attractive appearance. However, lacing cord must be removed if heavy winds are anticipated. Lacing cord generally will not break; therefore, a fence with laced windscreens may bend under heavy wind loads. 3) Springs give a neat appearance and have a protective feature in that they will usually break away in a strong wind. On the down side, they sometimes stretch irregularly, are expensive and can cause wear to the fence. 4) Probably most commonly used are polypropylene tie wraps which are inexpensive and can break away in a strong wind. Tie wraps come in various breaking strengths; the breaking strength chosen should not exceed the strength of the fence. Unfortunately, tie wraps generally last only one season since they deteriorate due to exposure and since they must be cut for removal.

One common method of affixing windscreens is to attach them permanently at the bottom with S hooks or hog rings and complete the installation with tie wraps. In a storm, the tie wraps break and the windscreens lay down on the court surface where they do not blow around and cause a player hazard or damage themselves flapping in the wind. For off-season storage, the tie wraps are cut and the windscreens are rolled, bedroll style, on the fence.

Maintaining Windscreens

Hose down windscreens occasionally. Repair tears immediately to prevent further damage. Always use all grommets to attach a windscreen in order to distribute stress evenly. Regardless of the type of fastener used to attach windscreens, replace broken fasteners immediately. Any loose section of the windscreen will whip in the wind, causing stress on remaining grommets, pulling them out or tearing the windscreen.

Storing Windscreens

Some tennis facilities detach the bottoms and sides of windscreens and roll the screens up bedroll-style on the fence for winter. Most, however, remove and box them. In areas of severe weather, removing and storing windscreens prolongs their useful life.

Hose down screens and allow them to dry thoroughly before removing them for storage. Tag each section of

screen and draw a diagram of the courts, indicating which section goes where. Remove the screens, roll them (rather than folding them) and store them in order, beginning at one corner and moving around the court. Either boxes or large plastic garbage bags are suitable for storage. Keep stored screens away from petroleum products, including gas and oil, and away from sharp objects, both of which may damage the screens.

Landscape Maintenance

Perform a seasonal walk through of the facility, noting any plants which show signs of injury or disease. Prune back trees and shrubs in the fall. Pay special attention to overhanging branches which pose a potential player hazard, create shadows, drop leaves and sap on the court and impede play.

If lawns around the facility are fertilized, care should be taken to avoid fertilizing close to the court surface or allowing fertilizer to wash onto the surface. Fertilizers will burn and discolor acrylic coatings and may damage other surfaces.

Special care should be taken in using weed whippers around the perimeter of tennis courts. They, too, may damage court surfaces, light posts and fences.

Chapter VIII

Repair, Reconstruction and Renovation

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Repair, Reconstruction and Renovation

Soft courts, grass courts and post-tensioned concrete courts, if well-constructed and well-maintained, will need major repair or reconstruction only after many years of use. Sand-filled turf courts may need to be patched as described in Chapter VII, but when badly worn, will need replacement. Therefore, this chapter will concentrate on the repair and reconstruction of asphalt and reinforced concrete courts. However, the section on renovation will discuss cosmetic and aesthetic changes which can enhance all types of courts.

In general, there are four levels of repair of asphalt and reinforced concrete courts:

1. Repair and Recoating - A court with proper slope and drainage, showing some wear, some stains, a birdbath or two and/or some small cracks, can be restored with repair and recoating. First, the court should be washed with a power washer to clean the surface and remove stains. Next, any cracks or birdbaths should be repaired. Finally, the court should be recoated with multiple coats of an appropriate tennis court coating by a qualified contractor according to the manufacturer's instructions.

2. Resurfacing - A court with proper slope and drainage, showing more serious deterioration or cracking, requires a more complete repair. The court may be resurfaced.

   The court should be cleaned and any cracks or low areas should be repaired, while any high areas should be leveled by scraping. Next, depending on the seriousness of the problems, one or more layers of asphaltic emulsion or acrylic resurfacer should be applied, allowing time for curing between layers. Finally, the court should be recoated.

3. Membranes, Stone Screenings and Overlays - If a court is badly cracked, it may be advisable to install a geotextile membrane or a layer of loose stone screenings to separate the old and new surfaces.

   Once the geotextile membrane or layer of stone screenings has been laid, an overlay of asphalt or reinforced concrete should be installed in lifts, allowing time for curing between layers. Finally, the court should be recoated.

3. Reconstruction - A court which is badly heaved or sunken, one with major structural cracking, or one with improper drainage or slope may need to be reconstructed. Less extensive repair methods may extend the court's life for a short time, but ultimately only reconstruction will solve the causes of such severe problems.

Reconstruction involves pulverizing and removing the old surface and regrading the subbase or pulverizing and reusing the old surface as a new subbase. Because many courts built in the 1960s, 1970s and 1980s are now quite old and show serious signs of deterioration, reconstruction is common.

4. Conversion - As an alternative to resurfacing or reconstruction, a court may be converted. If the court has proper slope and drainage, it may be overlaid with a modular surface, a roll-down surface or a sand-filled turf system. A court with improper slope or major structural cracking, may be converted to a soft court or to a post-tensioned concrete court.

Whenever resurfacing, overlay or reconstruction is contemplated, the decision as to which method should be undertaken is based on a number of factors:

the degree of deterioration of the court;
the causes of that deterioration;
the owner's budget for repair;
the owner's expectations for the life of the repair.

Whenever repair, resurfacing or overlay is chosen, it is important for an owner to realize that cracks always reappear. Therefore, if the owner expects a long-term solution, the court should be reconstructed. On the other hand, if funds are not available for reconstruction, all methods of repair will provide some additional life for the court and some methods of repair will extend the useful life of the court by many years. A qualified tennis court consultant or design professional or an experienced tennis court builder can help an owner determine the level of restoration required, appropriate methods and realistic expectations for such projects.

Recoating Asphalt and Concrete Tennis Courts

All asphalt and concrete tennis courts will eventually wear. In coated courts, wear may appear as smooth shiny spots or areas of asphalt or concrete showing through the color coating.

The rate of wear will be determined by the quality of materials used, by the quality of application, by the amount of court use and by the frequency and thoroughness of maintenance. The single most important factor in extending the life of a tennis court coating is keeping the coating clean and dry. Debris and dirt left on the court will stain the coating and abrade the surface. Water left on the court will stain the surface, encourage the growth of fungus and deteriorate both the color coating and, eventually, the surface itself.

When courts show evidence of wear, they should be recoated. Two to three layers of coating material should be applied according to the manufacturer's recommendations. See Chapter IV for more information regarding color coating systems for asphalt and concrete tennis courts.

If cracks or other surface irregularities are present, they should be repaired prior to recoating the courts.

Repair of Asphalt Tennis Courts

Cracking

The most common problem with asphalt tennis courts is pavement cracking. Cracking of asphalt is caused, at

least in part, by the natural tendency of asphalt to shrink as it weathers and ages. In addition, asphalt loses its flexibility as it ages, making it more brittle. Since outdoor courts are exposed to weathering, including expansion and contraction caused by temperature extremes, as asphalt becomes more brittle, cracking is inevitable. In fact, minor cracking may be visible in a new court the first time the temperature falls below freezing. This is not evidence of poor construction; it is the nature of the material.

Asphalt tennis court pavements crack more quickly than asphalt pavements used in parking lots, on roads and in other types of use. This happens because tennis court pavements do not benefit from the compressive kneading generated by traffic which helps to keep the asphalt pliable and delays cracking.

Premature or extensive cracking may be caused by poor asphalt mix design, by poor site conditions including expansive soils or excessive organic matter in soils resulting in subbase movement, or by poor construction including inadequate subbase compaction, improper slope or inadequate drainage.

One method of delaying or deterring cracking — the installation of control joints — has recently been explored. This method makes use of the natural tendency of asphalt to crack where it is weakest. During construction, the asphalt pavement is saw cut under the net and between courts in a multi-court project. These saw cuts provide a place for movement and shrinkage of the pavement when contraction occurs, preventing or minimizing the number and severity of cracks in other portions of the pavement. In addition, cracks from one court in a multi-court battery will stop at the control joint and will not travel to the adjacent court. The saw cut should be made with a Carborundum blade, not with a diamond blade and water, and the cuttings should be removed with compressed air. The asphalt pavement is saw cut one-half to two-thirds its thickness and the cut is filled with an elastomeric crack sealant. The sealant will require replacement every one to two years as it degenerates.

Quality design and construction can minimize or delay cracking but cannot eliminate it. Once cracking begins, no matter how skillfully it is repaired, the cracks will reappear.

There are many types of asphalt cracks. An experienced contractor or design professional can help an owner determine the specific types and causes of cracking and can recommend a method of repair.

Surface Cracks

Hairline Cracks

Hairline cracks are small irregular cracks present over large areas of the court. They do not affect the play of the game. Such cracks may be caused by natural weathering or aging, by foreign matter in the asphalt or coating material, by the use of solvent coatings, by improper application of coatings or by improper asphalt mix design. If untreated, hairline cracks will develop into more serious types of cracks and will require more extensive repair.

Alligator Cracking

Alligator cracking is a pattern of interlocking cracks over the surface, resembling an alligator hide. Such cracking may vary in depth from a very faint surface pattern to full depth cracking. Alligator cracking most often is a sign of heat checking.

Shrinkage Cracks

Shrinkage, or stress cracks, are a random pattern of interconnected cracks with irregular angles and sharp corners. They are small cracks, usually 1/16" (2mm) or less. Shrinkage cracks may be caused by the weathering of the asphalt, by improper mix design or by movement in the base or subbase.

Pavement Cracks

Heat Checking

Heat checking is a common occurrence during the compaction of asphalt, particularly when the asphalt is compacted in thin lifts. It occurs because the asphalt mix at the surface is at a different temperature from the asphalt mix 3/8" (9mm) - 1/2" (13mm) below the surface. As the roller turns, it exerts horizontal pressure. This forces the asphalt mix to move horizontally. If the asphalt on the surface has already cooled and begun to harden, it cannot move to follow the movement of the asphalt mixture below. Instead it cracks in a hair line crack pattern following the direction of the rolling. To prevent heat checking, asphalt should be installed in thicker lifts, at appropriate temperatures. The asphalt should be rolled at slow speeds, avoiding sharp turns, quick stops and starts, and before the mix has cooled. Check cracks may be sealed with surface coatings, but will reappear in 3 - 5 years. Fabric membranes are effective in retarding the recurrence of check cracking.

Structural Cracks

Structural cracks are larger cracks which penetrate the asphalt pavement. Structural cracks may result from the natural aging and shrinking of asphalt pavement. Often structural cracks appear as straight parallel lines running lengthwise on the court. Such regular structural cracks may be caused by weak paving joints in the asphalt pavement. Random structural cracks often are caused by heaving of the subbase due to freezing, inconsistent settling or other types of ground movement.

Reflection Cracks

Reflection cracks occur in asphalt surface overlays and mirror a crack pattern in the old pavement underneath. They are caused by movement in the pavement beneath the overlay or in the subbase or, if present in an asphalt overlay of a concrete court, they may follow the joints or cracks in the original concrete slab.

Footing Cracks

Cracks sometimes appear at the point where concrete net post, light pole or fence post footings meet the asphalt court surface. They occur because the concrete footing material and the asphalt court material expand and contract at different rates in response to temperature changes. Footing cracks can be avoided or minimized by using round post footings or by recessing the footing between asphalt courses and below the final courses, leaving a continuous asphalt finishing course.

Crack Repairs

At least three methods of crack repair are available. The appropriate method of crack repair depends on the type and size of the crack to be repaired.

Most commonly, small cracks are treated with a crack filler. The crack is first cleaned and dried. A tack coat may

be applied according to the manufacturer's instructions for mixing and drying. Next, the crack filler is worked into the crack with a putty knife or similar instrument. The crack must be filled; it cannot be merely covered. Pressure on the filler should be applied in all directions so that the crack repair material fills all spaces. Once the crack is completely filled, excess material on the surface is removed. When the crack filler has dried, the surface of the filled crack is smoothed to remove any ridges.

A relatively new method of crack repair is infrared patching. Using this system, new asphalt is bonded to the existing pavement, which has been infrared-heated, for a joint-free patch. The infrared unit can heat existing asphalt to a depth of approximately 2" (51mm). Once the pavement has been heated and softened, it is scarified. Next, new asphalt is added, rolled and compacted, filling in the void of the crack with new asphalt. Finally, the patch is heated to bond the new material to the old.

For larger cracks, a full depth repair should be undertaken. Any broken materials should be removed from the crack. If there is a defect in the underlying base course, the base material should be removed, as well, and the condition of the subbase should be observed. If the cause of the crack is inadequate subbase preparation or inadequate drainage, these conditions must be corrected before the crack is repaired. In fact, the presence of such problems may be an indication that the court is in need of reconstruction rather than repair.

If a full depth repair is to be undertaken, a tack coat should be applied to the sides of the crack and allowed to cure thoroughly. The crack should then be filled with a finely processed aggregate or with a mixture of dry sand and cement to a depth of 1/2" (13mm) below the court surface to create a bottom for the repair. Coarse sand and foam backer rods also may be used to fill a full depth crack. The choice of materials will depend on site conditions. A local contractor should be able to recommend suitable materials. Finally, a crack filler is worked into the remaining area of the crack, filling all voids. If the crack to be repaired is wider than 3/8" (10mm), hot plant mix asphalt may be used as a crack filler. Whatever material is chosen, pressure should be applied to insure that all voids are filled. Excess material is removed and, when the patch has dried, the patch is smoothed to blend in with the existing court surface.

Resurfacing

Repairing many cracks and/or birdbaths may leave a court with an unattractive freckled appearance; resurfacing will correct such an unsightly condition. Resurfacing also will correct a surface with other cosmetic defects, shallow depressions or overall shallow cracking. First, the individual cracks are filled. Then, one or more thin coats of acrylic tennis court resurfacer or asphaltic emulsion are applied. These materials, specially designed for tennis court resurfacing, fill in any imperfections in the surface texture and provide a smooth base for recoating.

Membranes, Stone Screenings and Overlays

The application of a complete asphalt overlay is recommended where the surface is badly stained or aged or where there is poor planarity, incorrect slope or poor surface drainage. The nature and seriousness of problems with the existing court will determine the depth of the overlay. The minimum depth of the overlay should be 1" (25mm) or twice the depth of the largest aggregate size in the asphalt mix.

Whenever an overlay is contemplated, the installation of a fiberglass or geotextile membrane or a layer of stone screenings between the old pavement and the overlay should be considered. These systems retard the transfer of cracks from the deteriorated playing surface to the new surface.

The use of fiberglass or geotextile membrane systems has become common in roadway resurfacing and has been adapted to tennis court applications. Before the membrane is applied, cracks and other surface irregularities are

repaired as described above. Then, the membrane is laid over the court. A single or double layer of membrane may be used. Some types of membranes are tack coat or adhesive-bonded to the old asphalt. Installation of a membrane will provide some resistance to recracking, but not as much as a stone screenings layer.

A layer of stone screenings is effective in retarding the transfer of cracks from the old pavement to the new overlay. However, if the new overlay cracks and water penetrates the pavement, the stone layer provides a reservoir which holds the water. Water under the court in the stone layer will quickly deteriorate the pavement overlay. If installation of a stone layer is contemplated, the old pavement should be perforated to allow any water which penetrates the overlay to drain into the pavement base.

After installation of the membrane or the layer of stone screenings, the repair is finished with an overlay of asphalt a minimum of 1" (25mm) thick after compaction. Often, an asphalt overlay is installed in two lifts, a 2" (51mm) base course followed by a 1" (25mm) surface course. A two-lift overlay can be used to correct a court with a crown at the net or incorrect slope or to repair major surface cracking. Each layer of the overlay is rolled and cured. Once the overlay is completed, the court is recoated.

It should be noted that an overlay, with or without a membrane or stone screenings layer, is a repair, not a reconstruction. Using a membrane or a stone screenings layer will retard further cracking, but continued deterioration of the original pavement will eventually affect the overlay.

Stripping

Stripping is one of the biggest problems in new asphalt. It shows up as large solid bubbles in the pavement. Stripping occurs when water gets between the asphalt and the aggregate in the asphalt mix and prevents the asphalt from adhering to the aggregate. Stripping may be caused by the presence of water in or on the aggregate, by rainfall seeping through shoulders, cracks or porous pavement, or by improper drainage and grading which allows subsurface water to enter the asphalt pavement from below. When stripping occurs, a determination of the cause of the stripping must be made before the condition can be corrected. Since water is the cause of stripping, the source of the water must be identified and eliminated. Depending on the cause and the degree of stripping, repairs may include everything from localized repair to reconstruction.

Heaving

Heaving, or upheaval, is the result of localized movement of some portion of the pavement. In heaving, a portion of the pavement is pushed up, often by frost expansion or by the swelling of moisture-laden expansive soil beneath the court, cracking the asphalt pavement. Reconstruction is usually required to remedy upheaval. However, prior to reconstruction, the cause of the upheaval should be identified and corrected or the condition will recur.

Depressions

There are several types of depressions in courts:

Dents or divots are small depressions, usually caused by racquets hitting the court, by chairs or other equipment on the court, by stones or keys or hard-soled street shoes. Such dents generally do not affect play of the game. They can, however, be repaired individually, using crack filler, or be corrected by resurfacing or by an overlay as part of a larger repair project.

Birdbaths are defined as any areas where standing water more than 1/16" (2mm) deep (commonly measured using a nickel) remains after drainage of the area has ceased or after one hour at 70 degrees Fahrenheit (21 degrees Celsius) in sunlight. Such minor depressions delay play after a rain and may cause staining on the court as they dry. They may be repaired by patching. First, the court should be flooded and the birdbath marked with a chalk line. Next, the area should be cleaned and allowed to dry. A tack coat should be applied to the area within the chalk line. The birdbath should then be filled with a thin coat or several thin coats of patching material (emulsified asphalt or acrylic material). The patch should be leveled with a straight edge and the area around the patch should be feathered and smoothed to meet the existing pavement. Finally, the patch should be allowed to cure and should be recoated according to the manufacturer's instructions.

Major depressions, accompanied by cracking of the pavement, are most often caused by insufficient compaction of the subbase, decay of organic material beneath the court, or water under the court causing undermining in the subbase. Reconstruction is usually required to remedy major depressions. However, prior to reconstruction, the cause of the collapse of the pavement should be identified and corrected or the condition will recur.

Rust Spots

In some parts of the country, the crushed stone aggregate used to construct asphalt pavements may contain iron. If iron is present near the surface of the court, it will oxidize, forming rust spots or streaking. Rust marks should be removed or pre-treated prior to resurfacing or recoating to prevent a recurrence.

Repair of Concrete Tennis Courts

Cracking

Most cracks in concrete courts are structural cracks. When concrete cracks, it usually breaks completely through. Structural cracks in concrete usually result from subbase movement. Such cracking is more common in reinforced concrete courts than in post-tensioned courts. The internal strength of the post-tensioned slab keeps cracking to a minimum. In addition, if a post-tensioned concrete slab cracks, the tensioning cables hold the cracks together.

The repair of structural cracks in concrete is very difficult since, in most cases, the slab is broken into separate pieces which move independently in response to expansion and contraction. Crack repairs, asphalt or reinforced concrete overlays often fail because the movement of the separate pieces of the slab causes reflective cracking in the overlay.

One way to increase the lifespan of concrete court repairs is to saw cut and seal the overlay. In this process, matching saw cut joints are created in the overlay directly over existing joints and cracks in the underlying concrete pavement. These cracks are then sealed to prevent water from entering.

Another way to delay or minimize reflective cracking is the installation of an asphalt crack relief layer. The crack relief layer, approximately 3 1/2" (90mm) thick, consists of a coarse, open-graded asphalt layer containing many interconnecting air voids.

If the existing reinforced concrete slab is seriously deteriorated, consideration should be given to cracking and seating or rubblizing the pavement prior to overlay. Cracking and seating consists of cracking the existing concrete pavement into pieces (1' (305mm) x 2' (610mm) to 4' (1.219m) x 6' (1.828m)) and stabilizing them by rolling

them into the subgrade with a heavy roller. In rubblizing, the existing concrete pavement is completely destroyed leaving a crushed concrete base.

Other options for cracked reinforced concrete courts include conversion to a post-tensioned concrete or fast dry court or installation of a sand-filled turf or modular surface over the cracked court.

Ravelling

Ravelling, or spalling, is the excessive wearing and loss of surface material, forming holes or pits 1/4" (6mm) to 2" (51mm) deep, on the surface of a concrete slab. In concrete courts, ravelling is often caused by the use of too much water in the concrete or by overworking the concrete, which may draw water to the surface, thereby weakening the structure.

Small areas of ravelling can be chipped out with a hammer and chisel and filled with latex patching material. A concrete patch should not be used since it will likely crack out again. Larger areas may be filled with asphalt patches, followed by an asphalt overlay.

Peeling

Peeling of the surface occurs when the acrylic coating fails to bond properly or loses its adhesion to the concrete slab. Concrete is difficult to coat due to the nature of the material. Even a well-constructed, properly coated court may show small areas of peeling. These areas should be touched up. More extensive peeling occurs when the concrete is improperly prepared prior to the application of the coating material, when concrete contains curing agents which reduce the bond between the coating and the concrete, or when water stands on the court surface.

Prior to repair of peeling areas, the cause of peeling must be determined. If peeling is determined to be caused by improper surface preparation, the peeling material should be removed, the surface prepared properly and the coating material reapplied.

If the peeling is found to be caused by curing agents in the concrete, the curing agent may continue to prevent a proper bond between the coating and the concrete. An asphalt emulsion or hot mix overlay may be necessary to effect a proper bond.

If peeling is found to be caused by standing water, the cause of the standing water must be corrected prior to repair of the peeling area, after which the peeling area must be removed, the concrete surface prepared and new coating material applied.

Bubbles

Bubbles in the color coating on asphalt and concrete courts most often are caused by moisture between the pavement and the coating material. The moisture can come from any of several sources. Both asphalt and concrete are permeable pavements. Moisture trapped below the slab can be drawn up through the pavement or the water may come from the pavement itself if the slab is incompletely cured prior to the application of coating materials.

Whenever water is present on, in or beneath a tennis court pavement, heat from a warm day may draw the moisture upward to the surface where it vaporizes and expands. The trapped vapor then breaks the bond between the coating and the slab, forming a bubble. Bubbles also may form between layers of coating.

Many modern coatings are semi-permeable and allow a small amount of moisture to escape. However, if larger amounts of moisture are present, if too many coats of surfacer have been applied, if the coats are too thick or if an impermeable coating material is used, the water cannot permeate the coating and bubbles are inevitable.

Rarely, bubbles may be caused by salt contamination during construction (from airborne salt, ground salt or salt in ground water) or by microbial action in which microscopic organisms produce carbon dioxide and/or methane gases forming bubbles.

Small bubbles may be punctured with an ice pick or nail and pressed down, which may make them re-adhere. Stepping down on bubbles only will be effective if there is still liquid or semi-dry binder under the bubble. If not, adhesive must be injected with a syringe to facilitate rebonding.

Large bubbles may be cut open and reattached to the pavement with an adhesive. Such patches are sometimes unsightly and bubbles may reappear. If the entire surface of the court shows bubbling or if bubbling recurs, the best approach is to remove the coating by sandblasting or by grinding or by using a high pressure washer and, then, recoating the court.

Installation of a vapor barrier or barriers in construction, construction of proper drainage, proper curing of the slab prior to coating and proper installation of coatings should prevent bubbling. When recoating an existing court, it is often better to remove old coats before applying new coating, since each additional layer of coating reduces the permeability of the surface increasing the likelihood of bubbling.

Reconstruction and Conversion

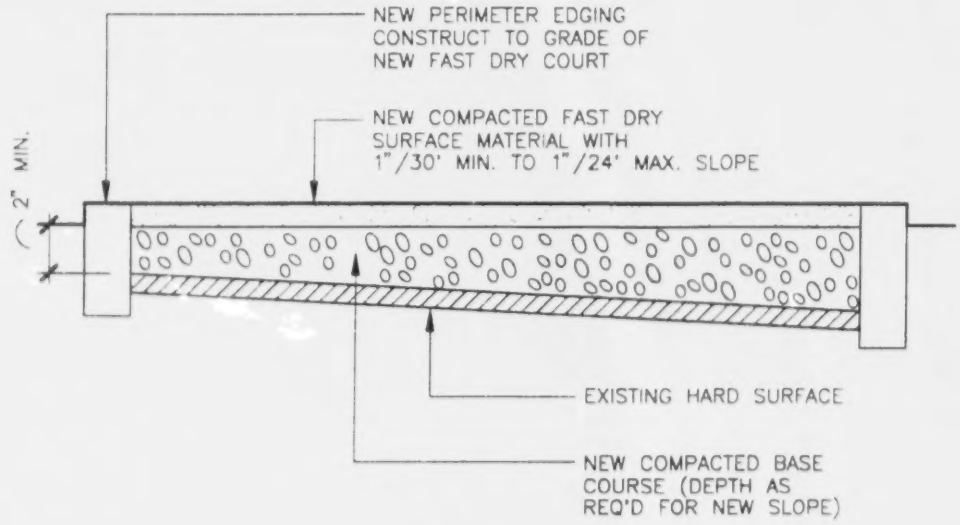
As an alternative to repairing cracked or deteriorating asphalt and concrete courts, such courts may be reconstructed or converted to a different surface. A court with proper slope and drainage may be overlaid with a modular surface, a roll-down surface or a sand-filled turf system. Such systems can be installed quickly and will extend the useful life of the court without major disruption to the landscaping, fencing, net posts, etc.

A court which is badly heaved or sunken, one with serious cracking, or one with improper drainage or slope may need to be reconstructed. Less extensive repair methods may extend the court's life for a short time, but ultimately only reconstruction will solve the causes of such severe problems. Depending upon the type and seriousness of the problems evident in the court, reconstruction may require the removal of the existing pavement and the excavation of poor base materials, the pulverization of the existing pavement, using the pulverized material as a base for the reconstructed court, or the removal of the pavement and base materials, regrading and reconstruction of the subbase.

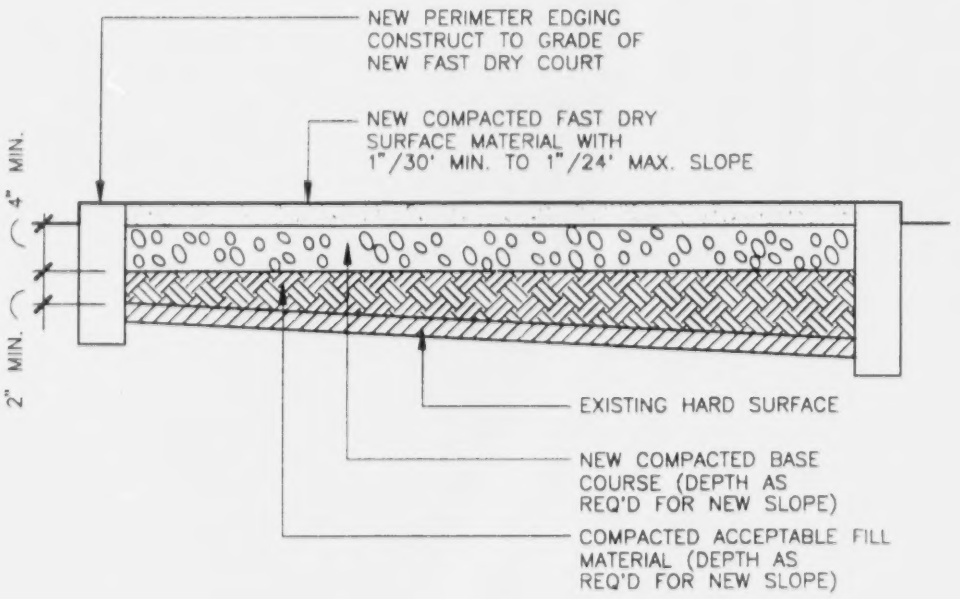
After the subbase and/or base have been reconstructed, new leveling and surface courses are installed as in new construction. Alternatively, following reconstruction of the subbase and/or base, the court may be converted to a clay or fast dry court or to a post-tensioned concrete court.

Drainage

Improper drainage makes surface damage more likely and more severe, especially in areas of freeze-thaw activity. Wet soil under the court will expand and contract in response to temperature, causing the surface to heave or to collapse. Poor surface drainage also may cause dirt or silt to accumulate on the court surface or cause damage to color coating systems. Prior to making repairs, correction of poor drainage is required. Installation or repair of surface or subsurface drainage systems should correct drainage problems. See Chapter II for more information on drainage systems.



ADJUSTING SLOPE WITH BASE COURSE



ADJUSTING SLOPE WITH FILL MATERIAL

CONVERSION OF HARD COURT TO FAST DRY COURT

NOT TO SCALE

CONVER - 1

U.S. TENNIS COURT AND TRACK BUILDERS ASSOCIATION

USTA

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Renovation

Renovating older tennis courts may involve more than repair or reconstruction of the court surface. A renovation may include an overall face-lift, improvements to fencing and lighting, and/or upgrading amenities and accessories, creating a more attractive and user-friendly facility. Among the repairs to be considered are:

Redesign

Older courts often were built in long banks side-to-side or back-to-back. Adding relatively few feet to one end of these banks often can make a tremendous difference. In long rows of side-to-side courts, a few additional feet at one end will allow courts to be reconfigured, after resurfacing, with more space between them. Installing low divider fencing between courts further improves the sense of player privacy and prevents balls from rolling across one court from another. Adding a little space in back-to-back courts can provide a walkway between two groups of courts to allow players to walk easily to the courts.

Fencing

Straightening the posts and rails on an older fence and replacing any damaged or missing parts is a good start for any court renovation. If the fence fabric is in good condition, remove snags and tears and tighten the fabric on the frame. Consider painting the entire fence dark green or black to provide a better background and to blend into the environment. If the fabric is rusted, bent or torn, replace it with dark green or black vinyl-clad fabric. Repair and rehang gates.

Newer fencing alternatives reduce the institutional appearance of courts and go a long way toward creating a more pleasant atmosphere. Among the options are the installation of wooden fencing, soft fencing or diagonal corners, or reducing the height of the fence on the sides of the court. See Chapter V for information on fencing alternatives.

Windscreens

Windscreens, also called backdrop curtains, enhance play by blocking out noise and visual distractions and by providing a background against which players can better follow the ball. In addition, properly installed, they give a court a neat, finished look. Adding windscreens or replacing torn or faded windscreens greatly improves the appearance of a tennis facility.

Net Posts

Net posts, light poles and other metal components of the tennis facility can take on a new look if sanded and painted. If net posts are bent or if they are older lever-type posts, they should be replaced with modern posts, both for appearance and for player safety.

Nets and Center Straps

A new net and center strap provide a fresh look at minimal cost.

Landscaping

Adding landscaping to a tennis facility can turn it into a tennis garden. Hedges or vines may be used in lieu of backdrop curtains to screen out noise and visual distraction, reduce wind interference and to add to players' sense of privacy.

Surface Conversion

Cracked asphalt or concrete courts can be converted to fast dry, roll down surface, or sand-filled turf courts without removing the old surface. Court conversions add variety to the tennis game and reduce the institutional feel of a facility.

Lighting

Old-style high mount flood lighting can be replaced with modern, environmentally-friendly low mount lighting, which is more attractive and more efficient. See Chapter V for more information on lighting alternatives.

Subsurface Irrigation Systems

Fast dry courts will play better and require less maintenance if kept uniformly moist. A subsurface irrigation system added during a renovation will greatly improve the performance of such courts.

Amenities

Shaded player seating, drinking fountains and practice lanes or practice equipment make any facility more playable. Adding walkways, benches, viewing areas, new signage and path lights creates a comfortable, player friendly, inviting ambiance. Remember, tennis should be a social experience.

For more ideas on accessories and amenities to include in a court renovation project, see Chapter V.

Chapter IX

Sources of Information

If so, be sure to call SportMaster. We have the color coating products you need for a vibrant, lasting tennis court surface. SportMaster 100% acrylic color coatings are available in nine attractive colors.

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Sources of Information

There are few references available in the field of tennis court construction and some of those are dated. This list is provided as a service. Readers are cautioned to evaluate each listed reference on its own merits.

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USTCC-TBA Construction Guidelines. U. S. Tennis Court & Track Builders Association, Ellicott City, MD, 1988, 1990, 1998

Trade Publications

Contact trade publications for back issues or for reprints of articles on construction topics.

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Governing Bodies

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International Wheelchair Tennis Association (IWTA)
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Fax: 011-44-171-381-3989
Governing bodies of international tennis and international wheelchair tennis.

Intercollegiate Tennis Association
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Princeton University
Princeton, NJ 08544
609-258-1686
FAX 609-258-2935
Governing body of collegiate tennis.

National Federation of State High School Associations
P. O. Box 20626
11724 Plaza Circle
Kansas City, MO 64195
816-464-5400
Governing body of high school competition.

United States Tennis Association
70 West Red Oak Lane
White Plains, NY 10604
914-696-7000
FAX: 914-696-7167
Governing body of tennis in the United States.

Glossary

acrylic coating
one of many polymers derived from acrylic acid; a liquid chemical compound (synthetic latex) used as a wear and color coat on non-porous tennis courts

aggregate
mixed stone, may include stone of various sizes, various shapes and/or various types

alligatoring or alligator cracking
a pattern of interlocking cracks over the surface of the court resembling an alligator hide; most often caused by heat checking

Americans with Disabilities Act (ADA)
federal legislation which requires that all facilities, including tennis facilities, be accessible to both players and spectators in wheelchairs and to those with other disabilities (i.e., visually impaired, hearing impaired, etc.)

annealed
the process of heating material (metal) for the purpose of making it less brittle

asphalt or asphaltic concrete
a mixture of asphalt binder, a liquid material refined from petroleum, and mineral aggregate that is compacted and cured to form a semi-hard pavement

asphalt penetration macadam
multiple layers of crushed stone bound together with spray-applied liquid asphalt

ASTM
American Society for Testing and Materials

ATP
Association of Tennis Professionals

average maintained illumination
the level of illumination of a new luminaire minus the light loss factor (LLF) specified by the manufacturer which generally ranges from 20% - 40%

azimuth of the sun
the angular measurement of the horizontal location of the sun along the horizon in relation to true north

birdbath
any area where standing water more than 1/16" (2mm) deep (commonly measured using a nickel) remains after drainage of the area has ceased or after one hour at 70 degrees Fahrenheit (21 degrees Celsius) or above in sunlight

brooming
the process of evenly distributing crushed stone or granular material with a broom on a surface

bull-float
pull by hand a flat wood board over freshly laid concrete (before it hardens) to provide a moderately level surface

burring
cutting off the rough edges to smooth; as in "burring tree stumps" which refers to cutting off the stumps but not removing them

channel drain
a type of gutter made of concrete or prefabricated sectional material with a grate on the top to prevent debris from entering

color rendition
whether or not the light source allows the human eye to see colors in the full range of the spectrum

compactible soil
soils which can be densely packed; usually inorganic soils such as sand and gravel, sandy loam and sandy clay, they often drain and dry quickly as well; desirable soils for tennis court construction

concrete
a mixture of cement, sand, aggregate and water, which cures to form a rigid pavement

cushion or cushioned course
a layer or layers of resilient material which provides shock-absorbing characteristics to a court surface

efficacy
a measure of the relative amount of power that is required to give off a certain amount of illumination

elastomeric material
a synthetic material having the properties of natural rubber, used to fill cracks or to create a shock-absorbing surface

emulsified asphalt binder
an asphalt combined with an emulsifying agent, clay plus water, to form a material that is easily worked out at ambient temperatures

expansive soil
soil which expands significantly when the moisture content is increased; often a soil which contains organic material

fast court
a court on which a moderately hard hit ball tends to have a long skid and a low bounce, and on which a ball hit with spin is not greatly diverted

fast dry material
a porous court surface material consisting of crushed stone, brick or tile that is ground, screened and, usually, mixed with a chemical binder

fines
smallest particles of fast dry materials or aggregates

foot candle
the English unit of illumination equivalent to that produced by a standard candle at the distance of one foot

footing drain
a type of French drain used on the uphill side of a retaining wall

French drain
a covered trench that serves as a barrier between a structure and approaching subsurface water

geocomposite
a material synthesized from natural stone

ghosting
the white residue left when the lime contained in new concrete migrates through the coating

gutter
an open, paved drainage channel

hairline cracks
small, irregular cracks, sometimes present over large areas of the court.

hard courts
courts made of asphalt and concrete, often surfaced with acrylic coatings or covered with roll or sheet goods or modular surfaces, generally non-porous

heat checking
a hairline crack pattern in asphalt courts caused by the compaction of a thin layer of asphalt; as the roller turns, it exerts horizontal pressure and forces the asphalt to move horizontally. In a thin layer, the top surface may cool and crack instead of moving.

heaving
(of pavement) a localized movement of a portion of the pavement resulting in cracking of the pavement and the cracked portion being pushed up; often caused by frost expansion or the swelling of moisture-laden expansive soils

hog rings
rings that are used to fasten a tension wire or wind screens to a fence

key stone
finely crushed stone embedded into a layer of larger crushed stone to keep the larger stone in place when being compacted with a heavy roller

life expectancy
the number of hours that a lamp will function or that a court surface will provide adequate performance

light control
refers to how well the light source can be aimed and limited or spread

LLF (light loss factor)
the measure of the loss of foot candles or light produced by a lamp over time; may be affected by climate, dust and dirt,voltage variations, luminaire design and maintenance

lumen output
a measure of light production

lute
a hand tool consisting of a straightedge approximately 30" in length connected to a long handle used in a raking motion to evenly distribute material on a surface (commonly used on clay or fast dry courts); also known as lute scarifier or scarifier

lux
the metric standard measurement of illumination (one foot candle equals 10.76 lux)

mounting height
the height the luminaire is mounted above grade

neoprene surface system
a synthetic rubber binder usually mixed with a rubber aggregate and sledded or troweled in place to provide a cushioned surface, usually finished with a spray-type surface system

nominal
in name only or common name; an example of nominal lumber is the 2" X 4" which, in actuality is 1 3/8" X 3 1/2"

non-porous court (impervious)
a court which does not permit water to permeate through the surface (water runs off the surface)

O.D.
outside diameter

peeling
coatings separating from the pavement in thin strips or small pieces; usually occurs when the coating fails to bond properly or loses its adhesion, most often in concrete courts

percolation test
a means of determining the soil's ability to absorb and disperse water.

planarity
in one plane; flat

plumb
true vertical

polyurethane surface system
a poured-in-place, self-leveling, elastomeric synthetic compound usually finished with a spray-type surface system

polyvinylchloride (PVC) surface system
usually a prefabricated, thin rubber-like material which is seamed and either totally adhered, perimeter adhered or laid as a loose blanket

porous court (pervious)
a court which permits some water to permeate through the surface

post-tensioned concrete
concrete reinforced by means of sheathed steel cables within the concrete slab which, after the concrete has begun to set, are tightened and held permanently under stress

poured-in-place
durable elastomeric synthetic compound, with a high degree of resilience, used to provide a cushioned surface; usually finished with a sprayed-type surface system

PPA (principal playing area)
the area within the court plus 6' beyond the sidelines and 10' behind the baseline

primer
a preparatory paint coat put on metal to inhibit rust or on another surface to improve adhesion of the finished paint coats

P.S.I.
pounds per square inch

ravelling
spalling, excessive wearing and loss of surface material forming holes or pits; often caused by the use of too much water in concrete or by overworking concrete which may draw water to the surface

reflection crack
cracks in surface overlays which mirror a crack patte n old pavement underneath

reinforced concrete
concrete strengthened by the inclusion of steel mesh, reinforcing steel (rebar) or reinforcing fiber within the slab

rubblizing
complete crushing of existing pavements, using the crushed material as a base for future construction

scarifier
see "lute"

scarifying
the process of loosening the surface of a fast dry or clay court using a steel rake, lute or other mechanical device

screed strips
horizontal metal or wood strips forming a frame and held in place to establish the top level to which material such as concrete, stone, clay or fast-dry material is placed

screenings
a fine gradation of sand, stone or other material which has passed through a series of wire screens having relatively small-sized openings

shrinkage cracks
a random pattern of small, interconnected cracks with irregular angles and sharp corners; may be caused by weathering of asphalt, improper mix design or movement of the base or subbase; also called stress cracks

short tennis
smaller court size designed for use by children

silt
fine grained material having little or no plasticity or cohesion

singles sticks
on a doubles court used for singles play, two posts not more than 3" square or 3" in diameter used to support the doubles net at 3' 6" at a point 3' outside the singles sideline (16' 6" from the center of the net/court)

slow court
a court on which a moderately hard hit ball tends not to skid very much and the bounce is generally higher than on a fast court, and on which a ball hit with spin will be diverted

slurry emulsion
a mixture of emulsified asphalt or acrylic binder and sand used to fill voids and depressions in a court surface

soft courts
courts made of clay, fast dry, grass and sand-filled synthetic turf; usually porous

spalling
chipping or crumbling of the surface; see ravelling

specifications
a detailed statement covering any or all phases of construction such as materials, methods, workmanship, responsibility, etc.

spill (in lighting)
the amount of light which falls outside the area where it is intended to fall

stress cracks
see shrinkage cracks

stripping
large solid bubbles occurring in new asphalt when water gets between asphalt and the aggregate in the asphalt mix

stroboscopic effect
the very rapid flickering of a light source

structural cracks
large cracks which penetrate the pavement down to the base material

subbase
the course in tennis court construction immediately below the base course (crushed stone or slag, gravel and sand, or combinations of these), which can be the subgrade soil if its quality is adequate

subgrade
the soil prepared to support the pavement system

swale
a natural drainage channel covered with vegetation, usually grass

tack coat
a dilute mixture of liquid asphalt spread over a surface to make the material being applied adhere to the surface to which it is being applied

tamping
the compacting of material with vertical blows usually using a heavy, flat tool.

trench backfill
fill material placed in a trench

uniformity ratio (in lighting)
ratio of the maximum illumination to the minimum illumination measured at a specified distance above the court surface (normally at a height of 36")

washed sod
sod that has had the soil removed from the root system

weep holes
openings in walls to permit passage of water collected behind walls

WTA
Women's Tennis Association

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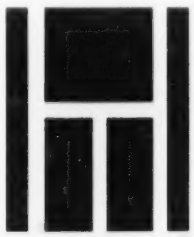

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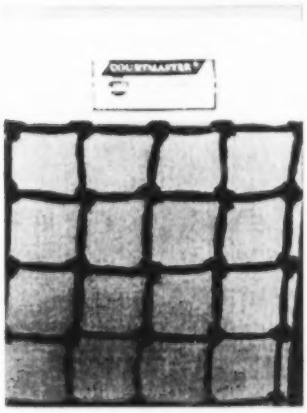

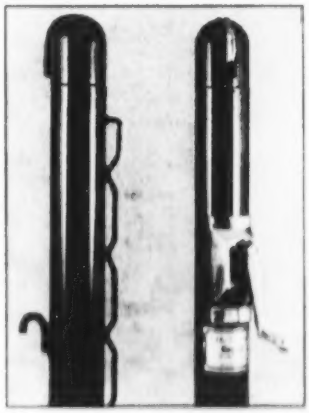

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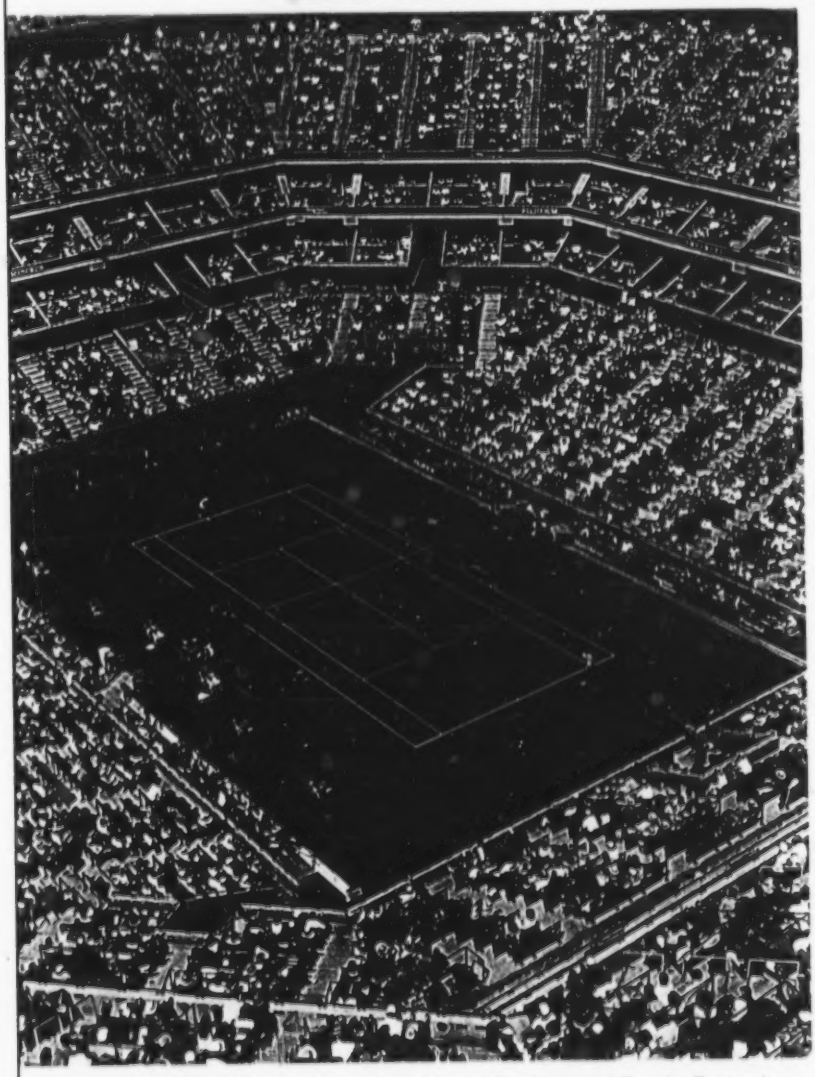

DecoTurf® *selected for use throughout the USTA National Tennis Center in NY, including its new center court at the Arthur Ashe Stadium.*

Why is **DecoTurf** the playing surface touring professionals and tournament directors demand?

Why is it the choice for the world's most prestigious tennis events?

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Since 1978 **DecoTurf** has been selected for use at the USTA National Tennis Center, site of the U.S. Open, and it's the choice of thousands of discriminating resorts, clubs, schools, municipalities and homeowners around the world.

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